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To Professor Strong -

With gratitude and best wishes.

George C. Andrews.

January 26, 1931.

DISEASES OF THE SKIN

A TEXT-BOOK
for
PRACTITIONERS AND STUDENTS

By

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PREFACE

As a ship that is built for service leaves the builder's hands to be launched on a career of usefulness with but a few words, so I send out this book with the hope that it will be of service. My driving force in writing it has been a keen desire to keep my knowledge up to date. Possibly this effort will also be found adaptable by some practitioners and medical students. I have endeavored to gather, and to present in a lucid and intelligible manner, the tried and conservative principles of dermatology with the most recent developments, to evaluate them and to correlate them into one satisfying, orderly whole. The requirements of modern practice have constantly been kept in view. Such an undertaking necessarily involves many pitfalls; and if I have been enabled to avoid these it is due to my friends and associates who have made this book possible.

Foremost, I wish to express deep gratitude to my wife for her never-failing interest and encouragement during the whole period of the preparation of this book. Special thanks are given to Dr. J. Gardner Hopkins and Dr. A. Benson Cannon, through whose generosity the clinical material and photographs of the Vanderbilt Clinic have been available for my use, and who have offered many valuable suggestions regarding the manuscript.

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Photographs have been liberally supplied from several sources, but I am particularly obligated to Miss Rhoda Benham for her excellent pictures of fungi, and to Dr. M. B. Parounagian for generously placing at my disposal hundreds of photographs of syphilitic patients taken in his service at the Bellevue Hospital during the past twenty-five years. Photographs of tropical diseases have been freely supplied to me by Dr. R. A. Lambert, Sir Aldo Castellani, Sir Philip H. Manson-Bahr, and Major J. E. Ash of the Army Medical Museum. I am indebted to Dr. F. W. Birkman for making many photomicrographs. Most of the photographs were prepared by Mr. Herman Pebler and the drawings were made by Mr. Alfred Feinberg.

Miss Emma A. Buehler has given untiring help and her academic training has been of inestimable value in the preparation of the text and bibliography. The enthusiasm of my secretary, Miss Millie R. Hess, has expedited the work, as has also the assistance of my nurse, Miss Kathryn Rogers.

I wish to thank Dr. R. J. E. Scott for his scholarly guidance in the editing of the manuscript and for the preparation of the Index and the chapter on Classification and Terminology. In addition, among the many circumstances for which I am grateful is the fortunate one that the publication of my book is in the capable hands of W. B. Saunders Company.

George Clinton Andrews.

New York City,
August, 1930.

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DISEASES OF THE SKIN

CHAPTER I

ANATOMY AND PHYSIOLOGY

ANATOMY

The integument is to be considered not only as an integral part of the body organism, but also as having special independent functions of its own. It is a complex, elastic, fibrous structure covering the whole body, and through its own connective tissue, with its numerous blood vessels, nerves, and lymphatics, it is in close relationship with the structures beneath. Although the surface of the skin, as a whole, appears to be smooth, it is traversed by ridges and furrows, which are fine and coarse according to location. These fine lines exist over the entire body surface, and in certain places, as upon the flexor aspects of the tips of the fingers and toes, are marked by a more regular pattern, which, however, differs in individuals. The larger furrows are much more pronounced in the neighborhood of the joints, and are due to the folding of the skin when movement occurs.

Hairs of various sizes are present upon most of the skin. Pores can also be seen. These are the orifices of the sweat and sebaceous glands. On the surface of healthy skin various cocci, bacilli, yeasts, *et cetera*, are regularly found. These are usually harmless saprophytes, whose presence is influenced by the cleanliness of the individual.

In a general way the skin consists of three layers: The epidermis, the corium, and the subcutaneous tissue.

Epidermis.—The epidermis (also called the cuticle or epithelial layer) is the outermost or surface part, and protects the more delicate underlying parts from trauma, chemical irritation, bacterial invasion, and other external factors. It may be conveniently divided into five layers, beginning with the most exterior: The stratum corneum, the outermost layer; the stratum lucidum, an ill-defined shining layer; the stratum granulosum, a granular layer; the stratum Malpighii or rete mucosum; and the stratum germinativum. It must be remembered that, although described in this order, the layers originate in the opposite sequence, *i. e.*, the stratum germinativum or basal-cell layer gives origin to all the others. By reproduction the cells of this layer are multiplied and, being forced outward, undergo various differentiations, which constitute their life history and culminate in the desquamation of the stratum corneum. In addition to these parts, the sebaceous glands, the sweat glands, the hairs, hair follicles and nails, known as the appendages of the skin, are considered as outgrowths of its structure.

1. The *stratum corneum* is the outer or surface division of the epidermis, and is thickest on the palmar and plantar areas and thinnest on the eyelids, prepuce, cheeks, forehead, abdomen, and flexor surfaces of the elbows. It is composed of epithelial cells which have become horny or keratinized. These

cells, containing a waxy substance, are flattened, dry, and non-nucleated, usually showing vacuoles. The periphery has become hardened and the prickles have persisted as dried up spicules of keratin. The cells next to the stratum lucidum are most perfect in structure; those near the surface, receiving little nutriment, become more and more flattened and dry.

2. The *stratum lucidum,* situated immediately beneath the stratum corneum, is an even, thin colorless, translucent or shining band. It is made up of one or more rows of somewhat distended irregular cells, with vestiges of nuclei which are shrunken and are occasionally replaced by detritus. The upper horny layers contain a protein, called eleidin, and fat globules. Neither the cells of the stratum lucidum nor those of the stratum corneum have nuclei that can be stained.

3. The *stratum granulosum,* or keratohyalin layer, is directly beneath the stratum lucidum, and is composed of one or several strata of flattened, coarsely granular cells, with shrunken protoplasmic fibers, and with shrivelled nuclei lying in spaces. The granules, variable in size and highly refractile, consist of a semisolid substance known as keratohyalin.

The stratum granulosum depends for its strength upon the development of the cutis papillae or the interpapillary rete cones. Whenever the papillae are poorly developed (as on the scalp and cheeks), the keratohyalin layer is a single row of cells, or may be interrupted. The back of the hand, with distinct papillae, has from two to three layers, the palmar surface, from two to six layers. The thicker the keratohyalin layer, the thicker is the horny layer. The keratohyalin layer follows the contours of the cones of the rete mucosum but nowhere extends deeply into them.

4. The *stratum Malpighii*—rete, rete mucosum, prickle-cell layer, stratum spinosum, as it is variously known—is made up of a varying number of rows of polygonal cells, which are built up like a mosaic. The cells differ in size according to the thickness and turgescence of the particular region in the epidermis. The protoplasm is spongy, and the nucleus, lying in the center, is large and oval, rarely round, and occupies half or more of the cell. The cells are united by delicate protoplasmic processes, because of which they have acquired the name of prickle cells. Nothing is known of the content of the prickle cell in the normal condition. These polygonal cells tend to become flattened in the higher layers, and the spaces between them are narrower, and the prickles, though distinct, are shorter than in the deeper cells. The nuclei and protoplasm both remain stainable. As soon as the prickle cell has become detached from the germinative cell of the basal layer, it has made the first step to its death, though it only now begins to show its real significance. The aim is the formation of the horny cell, and only in the dying stage does it function.

The Malpighian layer or rete mucosum is concerned in most of the pathologic processes of the skin.

5. The *stratum germinativum* (basal-cell layer) is the innermost layer of the epidermis. It usually consists of a single row of regular columnar cells, which are arranged vertically to the imaginary wavy basement-line separating the epidermis from the corium. These cells are gradually undergoing mitosis, their function being that of reproduction. During cell segmentation the layers of cells (daughter cells), pushed by the formation of new cells beneath them, gradually move up to the surface of the skin. The cells are arranged so that their lateral surfaces do not touch; there is always a small

space between them, over which stretch fine protoplasmic fibers. Every basal cell is thus connected by cell bridges with many surrounding cells. Merging into these cell bridges are fibrous trabeculae. These form a fine network within the cells and construct a cavity in which the nucleus lies. This reticulum or framework is called spongioplasm. In its spaces there are presumably liquid contents.

The nucleus is large and oval and lies at the center of the cell. Across the nuclei, when quiescent, there are threaded one or several chromatin nodules, which are designated nucleoli. During mitosis the nucleus becomes larger and turgescent and contains a tortuous chromatin filament which is arranged in the classical mitotic figures.

The basal cells are chiefly the carriers of the pigment granules (melanin) of the epidermis, which only under a strong pigmentation extend beyond the stratum basale to the stratum corneum. Fat is found inter- as well as intracellularly, and in the latter case principally in the vicinity of the nucleus. In acute inflammatory conditions, polymorphonuclear leukocytes frequently appear between the basal cells.

Corium.—The corium, also known as the cutis vera or derma, is a dense fibrous or elastic layer beneath the epidermis which gives strength and elasticity to the skin. It consists primarily of white fibrous tissue, which in variable amounts is permeated by yellow elastic fibers interspaced with a cement-like substance and cellular elements. It contains and supports the blood vessels, lymph vessels, glandular structures, hair follicles, muscle elements, prolongations of the fatty tissue, and the nerves with terminal organs of touch and sensation. The corium is beset over its entire surface with numerous conical papillae. This stratum is called the papillary layer, whereas the deep stratum is termed the reticular layer.

In the papillary layer—in contact with the epidermis—the bundles of white fibrous tissue are thin, loosely packed, and tend to be arranged in a vertical direction, while in the reticular layer—toward the subcutaneous tissue—they are coarse, and interlace, so the resulting meshwork tends to be arranged horizontally. These bundles are composed of numerous fibers of an albuminoid substance known as *collagen*, united by a semifluid material. The collections of elastic fibers, which are arranged parallel or obliquely to the collagenous fibers, are most numerous in the reticular layer and envelop the mesoblastic portion of the coil and glandular ducts, and the hair follicles. They are composed of an albuminoid substance called *elastin*. While the white fibrous bundles are incapable of branching, the elastic fibers arborize with neighboring fibers to form a network.

The papillae, in which are the terminal capillaries and sensory nerve endings, are finger-like projections of the corium that dovetail with the overlying epidermis. According as they are richly supplied with loops of blood vessels or with nerve endings, they are known respectively as vascular or nerve papillae. They are arranged in rows of varying height, and more or less parallel to each other. The papillae are more numerous in some locations than in others, and are found most abundantly on the terminal phalanges, penis, clitoris, and areolae of the nipples. In nearly all inflammatory diseases of the skin this part of the corium is much involved.

Within the corium there are fixed cells (ordinary connective tissue cells), vacuolated cells, mast cells, and migratory cells, principally leukocytes, which are more prominent near the blood vessels and in the papillary zone.

The connective tissue cells are generally spindle shaped and have nuclei with an open intranuclear network. The vacuolated cells, round or cubical, have a distinct nucleus, and the meshes of their spongioplasm are unusually large and rounded. The mast cells are of all shapes and are marked by the presence of numerous coarse basophilic granules in their protoplasm.

Subcutaneous Tissue.—This lies immediately beneath the reticular layer and may be regarded as a deeper layer of the corium, with loosely arranged, coarse trabeculae between which are quantities of fat cells. The roundness and fulness of the integument are due to the presence of the masses of these fat cells contained within the interstices of the connective tissue forming the "panniculus adiposus," and should they disappear, a looseness or wrinkling results. The subcutaneous tissue thus forms a pad which protects the delicate underlying structures, and a framework to support other parts, such as the sensory corpuscles, nerve trunks, coil glands, and blood vessels, and prevents too great a loss of heat by radiation and evaporation. Fat cells are large, spherical vesicles consisting of a globule of fat in an elastic capsule, with an oval nucleus at one side. The lobes formed by the trabeculae are subdivided by delicate fibrous tissue into lobules. The subcutaneous fat is traversed by a rich supply of blood vessels and lymphatics. Fat globules are absent in tissue in certain regions, as in the eyelids, in the auricles, on the penis, scrotum, and labia minora.

Epidermal Appendages

Sweat Glands.—These are long blind tubules whose lower end is arranged in a spherical coil, the upper end being the duct. The coil, which is the true secretory portion of the gland, lies in the reticular layer of the corium or in the subcutaneous tissue, opens into the duct, which passes through the corium in a spiral manner, enters the epidermis between the papillae, and as a corkscrew channel makes its way to the surface of the skin, where it terminates in a trumpet-shaped orifice. These glands are most abundant in the palms and soles, and are absent in the glans penis, the margin of the lips and the nail bed. There are two varieties: (1) Small glands (eccrine), which have only a watery secretion and are distributed over almost the entire integument; and (2) large glands (apocrine), whose secretion contains cellular débris. These are present only in the axillae, about the nipples, in the umbilicus, and in the genital and anal regions.

The walls of the coil are formed of a single layer of cells which vary in shape and size according to the amount of the contents. These secreting cells are low cuboidal when empty and at other times high columnar, containing a fatty granular substance. A thin layer of involuntary muscle fiber, especially well developed in the lower portion of the gland, encloses the epithelial cell layer, and rests on a distinct membrana propria. The duct in its passage through the corium has a uniform caliber, is lined with cuboidal epithelial cells, and surrounded by a delicate connective tissue coat. Where the duct traverses the epidermis it becomes a spiral cleft between the prickle cells and the horny cells, losing its distinct walls.

Sebaceous Glands.—These are small saccular glands, frequently branched, which are distributed over almost the whole surface of the body. Their ducts open into the hair follicles, and upon the glabrous surface of the borders of the lips and in the areolae of the nipples. In a modified form they occur in the eyelids, in the ears, on the penis, the inner surface of the prepuce, and labia minora. They are absent in the palms and the soles. These glands vary in size, being largest about the nose, scrotum, and areolae of the nipples.

The saccule, or secretory portion, is formed of low cuboidal cells, and the duct is lined with stratified epithelium enclosed in a connective tissue sheath that is derived from the corium or the hair follicle. The protoplasm of the cells of the inner layer forms fat droplets, which are discharged into the lumen of the duct, where they are mixed with degenerated cells and granular débris, which collectively is sebum.

Hair.—Hairs are present on all parts of the human skin, except the palms, soles, red portions of the lips, ungual phalanges, and glans penis. They are thread-like, more or less horny structures, varying in cross section in different races and in different individuals. Straight hairs are generally circular in cross section, and curly hairs oval, while the hairs of the beard are frequently angular.

There are three main *varieties:* (1) Soft long hairs, such as occur on the scalp, beard, mustache, axillae and pubes, and exceptionally on the midline of the trunk; (2) stiff hairs or bristles, such as the eyelashes, eyebrows, the hairs of the nasal orifices and of the auditory orifices; (3) lanugo or downy hairs, which occur on all parts of the body except where the other types are found, and except certain parts that are devoid of hair. In these there is usually no erector pili muscle present, and the sebaceous gland is large. The long hairs and the lanugo hairs as a rule are implanted obliquely in the skin; the bristles vertically.

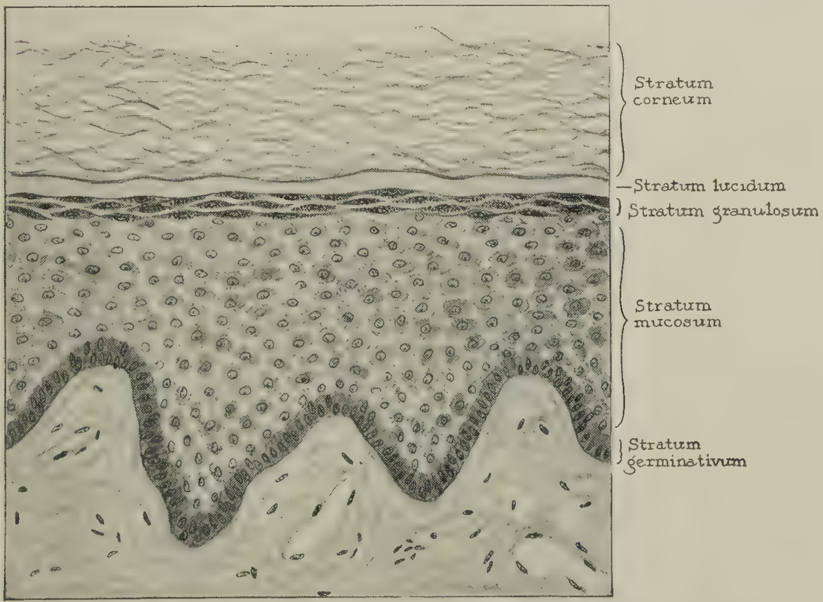

Fig. 1.—Diagram illustrating the anatomy of the epidermis. Highly magnified.

The *color* of the hair depends upon (1) pigment granules situated in and around the cells of the hair cortex, the responsible factor in black and brunette tints; (2) the diffuse color of the protoplasm of the hair cells, which produces blonde or reddish shades; (3) the presence of air between the hair cells, causing the hair to become gray or white. In the fetus all the hairs belong to the lanugo type, and are colorless except occasionally on the scalp.

Throughout life the hair changes at certain periods and in cycles. The embryonal lanugo hairs are shed toward the end of fetal life and are replaced by new hairs; at birth or immediately after, the hair grows actively on the scalp; at puberty it appears on the bearded region, the axillae and about the genital organs, and in middle life and later there are certain other manifestations.

Structure of the Hair.—The hair consists of a shaft or stem which at the lower end forms a bulbous swelling known as the bulb. The bulb and part of the shaft are contained in the pouchlike depression known as the hair follicle. The hair shaft itself is composed of the sheath or cuticle, the cortex beneath it, and in the center the medulla, this last, however, frequently being absent. Its usual position is then marked in a few instances by cavities extending for some distance along the shaft, but generally hairs without medullae are solid. Generally the medulla begins at some distance from the tip and ends near the bulb, and is most prominent in the intrafollicular portion.

The cuticle is a thin unpigmented layer of flat quadrilateral, overlapping scales, with their long axes directed upward and outward at an acute angle to the shaft. These cuticular scales vary in form, size, and arrangement.

The cortex, constituting the greater portion of the hair shaft, is composed of compact keratinized, nucleated cells, which, when isolated, are usually found to be fusiform or elongated. These spindle-shaped cells have ridges on the surface and interlock to form a highly resistant structure. Pigment is commonly present, either in the granular or nongranular form, or both. The cornification is so complete that in the absence of pigment the cortex is as a rule markedly translucent.

The medulla generally occurs only in the hairs of the scalp, beard, axillae and pubes, lanugo hairs containing none. It is far less dense than the cortex and is made up of rolls of plates of three or four flattened cells, which, near the hair bulb, contain keratohyalin granules. Among the medullary cells there are spaces filled by replaceable gas, probably in most cases air.

The *bulb* or root is softer and lighter in color than the shaft, and consists of the same two or three layers of cells, but these are much less differentiated and more cubical in shape than those in the shaft. The hair bulb lies within the corium or upper subcutaneous tissue, and is seated upon and embraces the hair papilla. The growth of the hair is a gradual process. The cells on the surface of the hair papilla proliferating rapidly form successive layers, which move the hair upward in its follicle.

The *hair follicle* closely surrounds the hair from the bulb nearly to the point of exit from the skin, and may be divided into an inner and outer epithelial sheath. The outer one rests on a hyaline membrane and is composed of cells of the character of the stratum germinativum. In the upper third the epidermal layers lining the follicle are the same as those of the epidermis. In the lower two thirds only the prickle cell and the basal cell layers of the epidermis persist. Toward the bottom of the follicle, the inner epithelial sheath may be subdivided into two concentric laminae, with a difference in the degree of cornification, the outer being designated Henle's layer, the inner Huxley's layer. Resting on the internal layer (Huxley's) and immediately in contact with the hair is a thin cuticle formed of scales, whose free margins downward and inward fit in between the cells of the hair cuticle. Therefore it is almost impossible to remove a hair without pulling out part of the root sheath. Lanugo hairs grow out of a rather rudimentary follicle. Enclosing the epithelial layers of the follicle there is a dense layer of connective tissue made up of collagenous and elastic fibers. In the outer portion they are arranged longitudinally, while nearer the hair they are circular. Next to the epidermal layer they become condensed and homogeneous, forming a hyaline membrane.

The papilla of the hair is a deep invagination, and is composed of connective tissue fibers supporting capillaries and one or more medullated nerves. By means of it the bulb is nourished. When a hair is situated with its bulb upon the papilla, it is known as a "root hair" or papillary hair. When a hair has completed its term of existence, it falls and is replaced by a new hair formed around the old papilla, and whose growth has frequently started before the old hair has been entirely cast off, the latter often being forced out by the new growing hair. As a hair completes its cycle of existence and before it is ready to fall, it becomes detached from the papilla and for a time is embedded upon the wall of the follicle. It is then designated a "bed hair." Before falling, every normal hair should go through this phase.

Nails.—The nails are convex translucent horny laminae situated on the dorsal surfaces of the distal phalanges of the fingers and toes. The large exposed area is called the *body;* the anterior extension from the body the *free edge;* the portion extending under the skin the *nail root.* There is a whitish crescent near the base of the nail (the lunula), which is due to a lessened translucency of the part. The nail lies on a mucous or soft layer, a specially modified portion of the corium, the *nail bed,* which beneath the nail root and somewhat anterior to it is known as the *matrix.* By continual division of the cells of the matrix the nail grows forward. The nail is bounded posteriorly and laterally by folds of skin, the *nail walls,* and from the latter, a thin membrane stretches crescent shaped for a short distance over the lunula.

The nail bed is composed of a prickle cell layer, beneath which is a papillary layer consisting of about sixty longitudinal ridges and furrows. Under this there is a rich subpapillary vascular plexus in which there are large venous sinuses.

On the under surface of the nail plate are parallel ridges and furrows which correlate with those of the nail bed, bringing them into close contact though not organically connected. The flat cornified cells constituting the nail plate have preserved nuclei, thus differing from those of the stratum corneum. These cells are arranged in layers, which can be distinguished near the matrix, but further forward are homogeneously knit together.

Blood Vessels

There are three distinct systems of blood vessels in the skin: A deep coarse one in the subcutaneous fatty tissue, a second of intermediate size situated in the corium immediately above the subcutaneous tissue, and a fine minutely ramifying one in the corium beneath the papillary layer. The deepest plexus runs parallel to the epidermis, and by liberal anastomosis supplies the adipose tissue and the coil glands. Small arteries traverse the trabeculae of the fat lobes, some branching into the interstices of the lobules and ending in capillaries between the fat cells; others, arising vertically from this plexus, form the subpapillary vascular network. Veins, though considerably larger, accompany the arteries. The subpapillary or superficial vascular plexus sends exceedingly fine, nonanastomosing arterial branches into the papillae, and forms an extensive network about the sebaceous glands and the hair follicles.

In the deeper parts of the cutis and in the subcutaneous tissue the blood vessels have muscular coats, but in the midcutis and subpapillary region, the walls consist only of endothelial cells.

Lewis and other investigators have found considerable independence of the capillary system of the skin from the arterial and venous circulation. The local regulation of currents in the capillaries is influenced largely by the metabolic activity of the cells. It is assumed that the tonus of the arteries and of the arterioles is under the control of the central nervous system, whereas the fine adjustment of the endothelial blood vessels is determined by the requirements of the tissue. Capillary pressure is independent of the arterial blood pressure. Rieder reported that the cutaneous capillaries are not influenced by periarterial sympathectomy, unless the cerebrospinal fibers are also severed. In diseases of internal organs the capillaries in the hyperesthetic zones react more strongly to various stimuli than the capillaries of normal skin, due to axon reflexes.

LYMPHATICS

Relatively few lymphatic vessels with distinct endothelial lining are found in the normal skin, but there are numerous intercellular lymph spaces in the epithelial layer of the epidermis and in the corium. The lymph from these spaces, which are not lined with endothelium, finds access into the vessels either between their endothelial cells or through stomata.

The lymphatic vessels originate in the papillae, pass down to a lymphatic plexus beneath the papillary layer, accompany the blood vessels obliquely through the corium and by anastomosing branches connect with the larger lymphatics of the subcutaneous tissue. Thus two networks are formed, the finer one of which lies beneath the papillae, and the coarser one in the subcutaneous tissue. The sebaceous and sweat glands, the hair follicles, and the papillae are all provided with networks of lymph capillaries.

NERVES

Both medullated and nonmedullated sensory nerve fibers are found in the skin. Medullated fibers from the subcutaneous tissue ramify upward into the corium in company with the blood vessels. In the papillary layer they lose their medullary sheaths, forming a network of fine fibrils which extend into the epidermis between the prickle cells as far as the stratum lucidum, there forming the interepithelial plexus. Numerous medullated fibers terminate in the Pacinian bodies, the tactile corpuscles and end bulbs, and also pass to the connective tissue coats of the hair follicles. Here they lose their sheaths and subdivide, forming a plexus between the epidermal cells of the external root sheath. The nonmedullated fibers probably supply the musculi arrectores pilorum, the sweat coils, and the blood vessels.

The *Pacinian bodies*, or corpuscles of Vater, are ellipsoid whitish structures located in the subcutaneous tissues. They are most numerous on the palms and soles. A single medullated nerve enters each one, loses its sheath, and terminates in a group of pear-shaped enlargements. Around this central fiber lie a central granular core and an outer capsule composed of concentric layers. These bodies are believed to be sensitive to pressure and traction.

The *tactile corpuscles,* or Meissner's bodies, or corpuscles of Wagner, are oval end, bulbs lying in the sensory papillae of the corium. They are universally distributed but are particularly numerous at the tips of the fingers and toes. They consist of a mass of connective tissue between which the nerve fibrils ramify and end in small bulbs.

The *corpuscles of Krause,* which are rounded bodies, are found chiefly about the sensory mucous membrane, the red portion of the lips, tongue, glans penis, and the clitoris.

The *touch cells of Merkel,* which are small round or pear-shaped cells, are situated at the termination of the medullary nerves of the papillae of the fingers and toes, and where the tactile corpuscles are few in number.

MUSCLES

The muscles of the skin are all of the smooth, or nonstriated, involuntary kind except a few voluntary muscle fibers found in the face.

The musculi arrectores pilorum are made up of small bundles of smooth muscle fibers which run from a neighboring papilla obliquely to the hair follicle, to which they are attached by elastic threads. The contiguous sebaceous gland lies in the angle between the follicle and the muscle bundles. On contracting they erect the hair, probably play an important part in regulating the action of the blood and lymph vessels, and in expressing the contents of the sebaceous glands. The elastic tissue of the muscle is continuous with the elastic network of the corium.

Larger masses of smooth muscle fibers arranged in layers are found in certain locations, such as in the skin of the scrotum, around the areolae of the nipples, and in the eyelids.

PIGMENT

The color of the skin is influenced by the amount of pigmentation and also by the degree of vascularity and by the subcutaneous fat. In the white races very little pigment is present in the skin with the exception of pigmented regions such as the areolae of the nipples, axillae, scrotum, around the anus, and in the hairs. In the dark-skinned races the pigment cells are more highly colored, and staining demonstrates pigment throughout the whole rete mucosum and upper corium, and usually to some degree in the cells of the horny layer.

The pigment of the skin is lodged chiefly in the cells of the stratum germinativum, appearing as a darkened streak above the papillary layer of the corium. In the Caucasian race it is sometimes found in the lower cells of the rete Malpighii and in the connective tissue cells of the papillary layer. The pigment granules—melanin—occur almost always within the cell, chiefly in the periphery of the cytoplasm, being absent from the nucleus and a zone about it. Melanin is an organic coloring substance, ranging in tint from light yellow and reddish-yellow to dark brown or even black. From melanin proper, which is a physiologic product, are to be distinguished pigments produced by pathologic processes.

In the skin there are three types of cells which contain pigment—the cells of the stratum germinativum, dendritic cells interpolated among these, and wandering phagocytes in the corium. Pigment cells may form their pigment autochthonously, or exotically by a kind of phagocytosis. In the former instance they are melanoblasts; in the latter, they are chromatophores.

Bloch[1] has shown, as far as the skin is concerned, that only the epidermal cells have the ability to form pigment—except in the sacral region where certain dermic cells are dopa-positive—and that each cell of the stratum germinativum is potentially a melanoblast. Among the cells of this layer there are certain ones which stain heavily with dopa. Such heavily pigmented cells are specially characterized by their dendritic form, and by anastomosis with adjoining cells, which produces a network. It is disputed whether these dendritic cells are derived from the basal cell layer or belong to the dermic sensory apparatus. They are variously called cells of Langerhans, melanoblasts, and Merkel-Ranvier cells. The presence of chromatophores, the cells which ingest the pigment, is always secondary and consecutive to the development of pigment in the epidermis. They are absent in instances where the epidermis does not elaborate pigment, or where, because of pathologic process, it has lost this function. The formation of typical chromatophores can be produced experimentally in the albino by the injection of artificial pigment into the dermis. Whether the pigment was produced in the cell autochthonously or by phagocytosis can be surmised by the form of the melanin granules within the cell.[2]

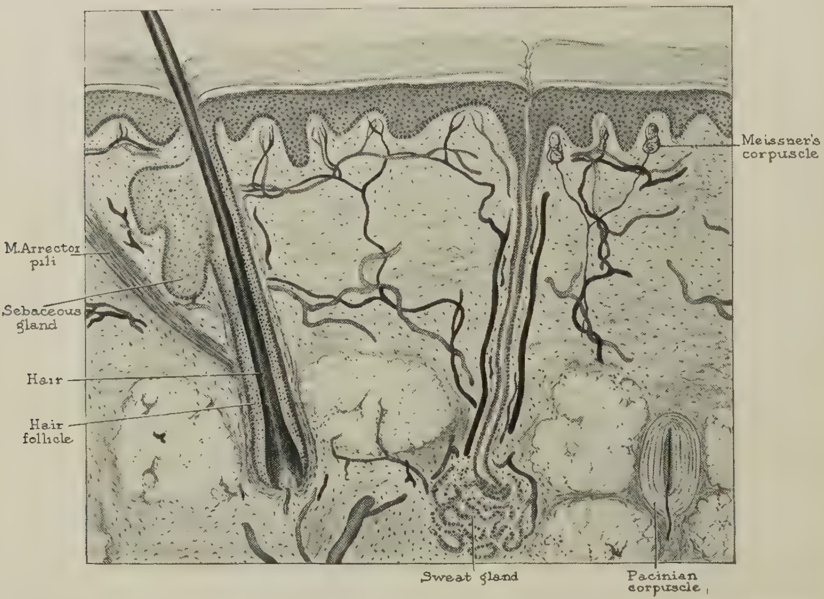

Fig. 2.—Diagrammatic illustration of the anatomy of the skin and its appendages.

The chromatophores, also known as melanophores, histiocytes, or reticulo-endothelial phagocytes, become engorged with pigment from external sources from the melanoblasts, and thus become melanotic. They lie in the upper corium and are irregularly shaped derivatives from the fixed connective tissue cells.

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[1] Bloch, treating sections of normal skin with a solution of dioxyphenylalanin, an amino-acid (called dopa), found that deeper layers of the epidermis were stained black or gray, viz., the cells of the basal layer, of the outer sheath of the hair follicle, and of the hair matrix—and the intra-epidermic dendritic cells known as the cells of Langerhans assuming a particularly dark tint. There occurs both granular and diffuse staining of the protoplasm. Bloch devised a theory to account for this reaction in the cells, ascribing to them an enzyme which he called "dopa oxydase." The special color (or pigment) was interpreted by him as resulting from the production of dopa melanin by the oxidation of dopa by the oxydase.

[2] Smith, D. T.: Evidence Showing the Existence of Two Distinct Types of Pigment Cells Capable of Giving Rise to Melanotic Tumors, Bull. Johns Hopkins Hosp., 36:185–196, March, 1925.

There is much divergent opinion as to the genesis of melanin, and it is questionable whether all melanin has the same origin. Its chemical composition is not known and may vary in different cells. The number of organic combinations from which dark bodies may originate is extraordinarily large, and the transformation of an organic melanogen into its final product is a complicated process not yet explained. It is certain that, in addition to oxidation, condensation and polymerization into large molecular aggregations play an important rôle. The formation of the melanin is not a splitting up into simpler products, but a building up into a complicated body.

Bloch, in his researches, has shown that the normal development of melanin originates in the cells derived from the ectoderm, especially the basal cells of the epidermis, in the follicles and matrix of the hair. According to theory, however, both the ectoderm and mesoderm have the power, under certain circumstances, to differentiate cells which can form pigment. According to Bloch, in the human skin mesodermic pigmentation shows only a rudimentary development in the Mongolian spot, of which remnants exist in all the newborn of the Caucasian race. Melanoblasts of the dermis ("Mongolian cells") are probably of mesodermal origin and represent some atavistic remnants. Melanin is found in several organs and tissues, whether they be of ectodermic or of mesodermic origin.

The formation of pigment from its colorless preliminary stages by the specific cells is a process of oxidation due to a ferment contained in the protoplasm. To this ferment Bloch has given the name "dopa oxydase" because of its relation to 3-4-dioxyphenylalanin. The cells which are capable of pigment genesis due to the dopa-oxydase content give a positive reaction when stained with 3-4-dioxyphenylalanin, the latter being transformed into dopa melanin. The dopa reaction is always negative in epidermis deprived of pigment formation (albino and white hair) and in those areas where this function has been lost (depigmented cicatrix and vitiligo).

DEVELOPMENT OF THE SKIN

Embryologically, the human skin is formed by the union of the ectoblastic and mesoblastic layers of the blastodermic vesicle. The histologic structure of these primary layers displays early differences in the compactness, regularity, and arrangement of the component elements which distinguish them. Later, those which are epithelial appear comparatively regular and firmly welded, whereas those which are connective tissue have a profuse amount of intercellular substance and irregular stellate-shaped cells. From the ectoblastic layer is developed the epithelium of the integument together with the epithelial appendages of the skin—the hair, nails, sebaceous and sweat glands, and the involuntary muscle of the latter. From the mesoblastic layer the corium is derived, including the connective tissues, the muscular tissues (except those of the sweat glands), and the tissues of the vascular and lymphatic systems.

At first the ectoderm is composed of one layer of cells, but very early it becomes divided into a basal and a covering layer—which are respectively the stratum germinativum and the periderm. The latter, which is external, is the forerunner of the permanent stratum corneum. Its cells are small and flattened, and when exfoliated become a part of the vernix caseosa.

The stratum germinativum, which at first is a single row of columnar cells, becomes divided into a basal layer of cylindrical cells, and an intermediate layer of irregularly polygonal cells, which in later fetal life develop into the stratum spinosum. This layer in the course of time forms many rows of flattened cuboidal cells, the outermost of these developing granular cytoplasm —the stratum granulosum—and containing the nuclear product keratohyalin. The protoplasmic fibrils of the prickle cells begin to develop in the fetal skin and gradually increase in number to form bridges from one cell to the other.

The junction of the epidermis and corium takes the form of a series of elevations and depressions, which fit into each other. The elevations of the corium are the papillae.

The corium originates from the cutis plate, which is the lateral stratum of the myotome, the denser part of the principal cell mass of each somite of the mesoblast. The corium and stratum germinativum consist originally of very similar tissue elements. A sharp demarcation between the true cutis and the subcutaneous connective tissue can be made only after the third month of development. The true corium shows a weaker development of connective tissue, but characteristic spindle cells. The separation into the papillary layer and the reticular layer occurs at the end of the sixth month. The cutaneous nerves show structure early, appearing as cavities lined with a simple endothelium.

The beginnings of these changes have been recognized during the second month of intra-uterine life. They continue at a rapid rate during the third and fourth months but more slowly thereafter. The skin appendages show the first noticeable signs of development during the third and fourth months of fetal life. The lanugo hair breaks through the surface some time in the fifth month.

Of the appendages of the skin, the hair is first indicated by a thickening in the ectoderm due to the formation of a compact group of cells which project club-shaped into the corium. Here there is some reaction showing as an accumulation of nuclei beneath the epithelial downgrowth. The latter becomes cylindrical, and its deep extremity is indented by the developing hair papilla. The epithelial downgrowth becomes differentiated, with a neck and a bulb, and compact groups of cells indicate the future sebaceous gland. A connective tissue sheath is organized from the mesenchyme surrounding the downgrowth, while groups of nuclei beneath it show signs of the developing hair papilla and the arrector pili muscle. The differentiation in the follicle progresses, the sebaceous gland and the epithelial bed being developed. During this stage, above the papilla, which early contains blood vessels, a large accumulation of epidermal cells forms the rudimentary hair bulb. The internal root sheath grows, and the external layer of Henle and the internal layer of Huxley are present. In the bulb the cells from which the hair itself will form are observed; the hair shaft definitely appears and pushes its tip above the surface of the skin.

The sebaceous gland develops from a group of cells lateral to the hair bulb. The group sends out lateral off-shoots, and small fat granules appear in their central cells. Alveoli form and the complete sebaceous gland develops.

A thickening of the epidermis, called the primary nail fold, upon the dorsal surface of the distal phalanx is the first sign of the formation of the nail. The nail fold is demarcated by the nail groove, which is a shallow depression along the proximal and lateral portions. The nail fold ends in a transverse plate, which is covered by the eponychium. The cells of the transverse plate become cornified and form the permanent nail, which grows further and breaks through the eponychium, a remnant remaining as the cuticle.

The sweat gland develops in the form of solid cords of cells from the stratum germinativum, which penetrate downward into the cutis. After the longitudinal growth is completed, corkscrew-like convolutions appear in the upper portion to form the excretory ducts. The cells at the deep part of the downgrowth become separated by a secretion and gradually develop into a gland lumen, whose orifice becomes connected to the lumen of the duct. The nonstriated muscle fibers of the sweat glands, situated between the basement membrane and the lining epithelium, are derived from the ectoderm, this being the only place where muscle tissue does not originate in the mesodermic layer of the blastoderm.

PHYSIOLOGY

The skin has a number of physiological functions: (1) protection; (2) reception of sensations; (3) regulation of body heat; (4) secretion; (5) respiration, and (6) absorption.

Protective Function.—The several layers of the skin, together with the nerves, glands, and appendages, share in the function of protection. The stratum corneum with its keratinized, firmly knit, cellular structure acts as a shield against injury and as a barrier to the invasion of micro-organisms. Too rapid loss of liquids and heat, and the absorption of toxic substances are prevented especially by the horny cells due to their waxy content. The fatty secretions of the sebaceous and sweat glands assist in the protective function of the skin by keeping it covered with a thin coating of grease. The elasticity and firmness of the corium with the fatty meshwork of the subcutaneous tissue afford protection to underlying structures from pressure, blows, and other agents. The skin is also highly inert chemically, and in respect to its composition seems extraordinarily well adapted to its function of protection.

The adipose tissue may likewise act as a reserve supply for nutrition in case of need. Echstein and Wile, by chemical analysis, have shown that approximately one fifth of the lipoid extracted from the human skin is present as free cholesterol. This would seem to furnish a reasonable presumption that light activates the cholesterol in the skin, thus accounting for the antirachitic property of treatment by ultraviolet light. The importance of the skin as an organ of storage for water and carbohydrates, and possibly other physiologic substances, has been indicated by recent laboratory experiments on animals.[1]

Sensory Function.—The skin is richly supplied with nerves, by means of which the body is kept adapted to changes in its environment. It is sensitive to touch, heat and cold, pain, pressure, and traction. The sensory nerves are not continuous and uniform over the entire body surface, for there are sensory spots which are interspersed with nonsensory ones. The sensory nerve endings vary in the type of sensation to which they respond, and in acuteness, so that each sense as of heat and cold and pressure, *et cetera*, may be considered as having its own distinct nerve apparatus. The cutaneous pressure points are smaller and more numerous than the cold or warm spots. Around the hair follicles the touch spots are most profusely distributed. The hairs themselves constitute very effective tactile organs, a liberal plexus of nerve fibers being located around the root of each hair. With tactile discrimination there is also frequently compounded an element of muscular sense, for through it are made known the size, weight, and other characters of bodies. This epicritic sensibility is most highly developed in the finger tips, where the majority of the tactile corpuscles and sensory nerves are found.

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[1] Folin, O., Trimble, H. C., and Newman, L. H.: The Distribution and Recovery of Glucose Injected into Animals, J. Biol. Chem., 75: 263–281, Oct., 1927.

Function of Heat Regulation.—The skin regulates the amount of heat lost from the body surface through radiation, conduction, and evaporation, thus helping to maintain a constant body temperature. Heat causes dilatation of the cutaneous vessels, more blood being brought to the surface, and more heat being lost by radiation. On the other hand, cold causes the vessels to contract, the blood is kept away from the surface, and less heat is lost by radiation. Heat and cold act either indirectly through the vasomotor nerves or directly on the involuntary muscle fibers of the vessels of the subcutaneous tissue. The part of the sweat glands in controlling the heat of the body is discussed below.

Secretory Function.—Through the sweat and sebaceous glands the skin acts as a secretory organ. They keep it soft and lubricated, and thus play an important rôle in regulating the body temperature. That the latter is the principal function is considerably supported by a study of the class of cases with a total absence of sweat glands.[1] The consensus of opinion points to the conclusion that as an excretory organ the skin is of little value.

Sweat.—The secretion of sweat is under the control of the central nervous system. The amount varies greatly, being influenced by the condition of the atmosphere as regards temperature and moisture, as well as various physical and psychical states, such as exercise and emotions. External temperature affects the irritability of the glands by direct action either upon the glands or upon the terminal end fibers. The sudoriparous glands are not very responsive to chemical changes in the blood, as the kidneys are; they are unable to excrete waste products in concentration. Barney stated that there is an apparent diminution in the output of nitrogenous elements of the sweat in so-called senile eczema, and Brill found a diminished secretion of sweat and a relative decrease in chlorine content in eczema.

Adolph came to the conclusion that the composition of sweat varies with the region and with the duration of sweating, but not with atmospheric conditions. The consistency of the secretion of the sweat glands depends upon the location of the glands,[2] those situated in the axillae and around the anus secreting a thick, oily substance, while those of other parts of the body secrete a colorless fluid, the sweat proper. A certain amount of water is constantly being evaporated from the body surface as insensible perspiration. This is not a secretion of the coil glands, for a person with a total absence of sweat glands eliminates a normal amount of water through the skin when at rest in a cool atmosphere. Sweat proper, a secretion from the glands, is an important emergency factor for the regulation of body temperature in exercise, fever, fear, *et cetera.* When the temperature of the body rises, considerable quantities are poured out which evaporate and produce a cooling effect.

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[1] MacKee, G. M., and Andrews, G. C.: Congenital Ectodermal Defect, Arch. Dermat. and Syph., 10 : 693–697, Dec., 1924.

[2] See page 865.

Profuse sweating, diaphoresis, is induced either by drugs or by methods of raising and keeping raised the body heat, or more rarely by nausea, weakness, or emotional excitement. Drugs employed therapeutically to increase the sweat are pilocarpine, whisky, Dover's powder, sweet spirit of niter, and camphor. Muscarine, strychnine, nicotine, and physostigmine exert similar effects, but are so dangerous that their use is restricted to laboratory investigations. The body heat may be raised by exercise, by the prevention of heat loss as with blankets and heavy clothing, by the use of artificial heat, either internally or externally—internally by hot drinks, and externally by hot baths or the hot pack. The amount of sweat is diminished by measures which lower the body temperature and by atropine. Sweating is also influenced by bacterial toxins, especially when fever is produced.

The sweat is normally acid and thus is a factor in protecting the skin from the growth of micro-organisms. It becomes neutral or alkaline when produced in large quantities, and for long periods of time, or when diluted with transudate from the blood vessels. It has a low specific gravity (1.004). In addition to a large percentage of water (98.8 per cent), sweat consists of inorganic salts, especially sodium chloride, small quantities of alkaline sulphates, and phosphates, and traces of various other constituents, neutral fats, volatile fatty acids, cholesterol, urea, uric acid, and creatinine.

Sebum.—The product of the sebaceous glands is an oily semifluid material composed of fat in granules and in drops, fatty acids, cholesterin crystals, salts, albuminoids, and water, mixed with fatty degenerated cells, and cell detritus. To some extent the amount and consistence vary according to the individual, and also on different parts of the body. It is generally more abundant where the glands are largest and most numerous. In it there is frequently found a microscopic mite, the Acarus or Demodex folliculorum, which is usually considered harmless. When exposed to the air sebum becomes a cheesy mass.

The production of sebum is a slow but continuous process, though it is probably quickened by an increased vascularity of the gland and a rise of temperature. The exact mechanism of production is not fully understood. Evidently some relation exists between the sebaceous glands and the generative organs, for at puberty and at the menstrual period the glands show increased activity.

The chief function of sebum is to lubricate the hairs and prevent them from becoming dry, brittle or too easily saturated with moisture. The sebum also spreads over the skin around the orifice of the hair follicle, forming a thin protective coating which prevents an undue loss of heat from evaporation of the perspiration.

Function of Respiration.—As a respiratory organ the skin has only a slight function as compared with the lungs. It is capable of eliminating water vapor and carbonic acid gas. Water is given off in large quantities, being almost double that from the lungs. The amount of elimination of moisture from the skin is proportionate to the temperature, being approximately a liter in twenty-four hours. Two or three times this amount may be excreted during exercise. The amount of carbon dioxide given off is small, about 7 to 8 Gm. in twenty-four hours. The loss of carbon dioxide rises with an increase of external temperature and when there is marked sweating. Possible modes of exhalation have been suggested: (1) Through the sweat glands, or (2) from the capillaries of the papillae.

Function of Absorption.—It may be regarded as established that the epidermis due to the stratum corneum is practically impermeable to the absorption of water, aqueous solution of salts, alcohol, and other substances, except at the orifices of the sweat pores and the pilosebaceous follicles. By inunction unbroken skin may absorb gases, oils and fats, and substances dissolved in fatty vehicles, the degree of absorption depending upon their power of becoming volatilized at the low temperature of the body. Although it has been demonstrated that hair follicles, sweat glands, and sebaceous glands are not necessary for such absorption if the substances are applied with friction, it apparently occurs especially at these orifices, for there they mix with the fatty secretions. If the natural skin fat be removed by ether, or if the vascularity of the skin be increased, absorption takes place more readily. When the horny cells become swollen and sodden through prolonged contact with water, some absorption of substances suspended in fats may result. If there is an abrasion of the skin, absorption by the papillae readily takes place.

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CHAPTER II

ETIOLOGY AND PATHOLOGY

GENERAL ETIOLOGY

THE causes of skin diseases are many and varied. The skin being a protective body covering and in close relationship to underlying and internal structures, as has been said, is subject to the influence of numerous external agents and internal disturbances. The cause of many skin diseases is unknown, and in others it is frequently difficult to define and locate.

Predisposing Causes.—As predisposing or contributory causes will be discussed later in more detail, they will be only briefly considered here.

The *general health* bears a definite relation to certain diseases. Lowered resistance of the body tissues, a debilitated condition, impaired circulation, other defects and disorders of special organs often have a direct bearing on cutaneous disturbances. Lichen planus and pruritus may be connected with disorders of the nervous system, and dermatitis herpetiformis with pregnancy. The course of many dermatoses of bacterial origin is influenced by impaired vitality, anemia, and constipation; whereas other dermatoses are unusually recalcitrant in those affected by diabetes or gout.

Some diseases have been observed to exist more frequently in certain *climates* than in others, as well as in special countries. Yaws and other affections are limited to a tropical climate. Leprosy is more common in some countries, favus and pellagra prevail widely in Italy, and prurigo and lupus in Austria. However, the mode of living, the kind of food, the habits of the people as to sanitation and personal cleanliness are responsible factors, in addition to the climate.

The different *seasons* in the same region have an effect upon the occurrence of certain eruptions; for instance, chilblains and pruritus hiemalis are peculiar to the cold season; eczema and psoriasis appear aggravated at this time; while prickly heat and hydroa aestivale are affections incident to hot weather.

Race has some connection with the occurrence of only a few cutaneous diseases. The skin of the white race is comparatively delicate and consequently more subject to disease than the thicker and more heavily pigmented skin of the negro. However, keloids and leukoderma are known to occur frequently in colored people, the former attaining large proportions. Elephantiasis too is of comparatively more common occurrence among them, whereas psoriasis and lupus erythematosus are rare. Multiple pigmented sarcomas of idiopathic origin are seen most often in the Jewish race, as are dermatoses arising from nervous disorders.

Age and *sex* are both predisposing factors in the causation of cutaneous diseases. At some ages certain diseases are more frequently encountered than at other times. In early life such affections as infantile eczema, pemphigus neonatorum, congenital syphilis, dermatitis exfoliativa neonatorum, and certain exanthemata as chickenpox and measles are of common occurrence. At the age of puberty diseases of the sebaceous glands appear, as the glands are then hyperactive. Carcinoma is essentially a disease of old age.

Women are more often subject to such affections as dermatitis herpetiformis, erythema induratum, and Paget's disease; men, to sycosis, epithelioma, and the various occupational dermatoses.

Occupation has been noted so often to be an etiologic influence in diseases of the skin that to this group of inflammatory affections the name of "occupational dermatoses" has been applied. In the various trades, in agriculture, industry, and the household, substances that act as irritants to the skin are frequently handled. Of late years this group of cutaneous affections has grown numerous and consequently of such importance as to warrant detailed consideration, which is given elsewhere. A comprehensive volume devoted exclusively to this subject has been published by R. Prosser White.

Heredity, at the present state of investigation, plays an uncertain rôle as a predisposing cause in diseases of the skin. The distinction between hereditary and family diseases is not sharply drawn. Several members of the same family may be afflicted with a disease that is rarely found in different generations. A predisposition to a disease or a hereditary weakness, as to tuberculosis, is transmitted rather than the disease itself. Leprosy may also be an example of inherited tendency. On the other hand, syphilis, icthyosis, leukoderma, and hypertrophy of the nails are congenital, as are such lesions as vascular nevi and moles. Keratodermia has been known to affect persons of different generations. Albinism, a condition affecting the pigmented structures of the body, the skin, hair, iris and choroid, is considered hereditary, as also are some forms of alopecia. Icthyosis, in addition to being an hereditary disorder, has been noted in several members of one family, which occurrence is likewise common in xeroderma pigmentosum. In psoriasis heredity is known to be a variable factor. It may be found in several generations or as an isolated instance.

Certain diseases of the integument as atrophies and hypertrophies are *idiopathic conditions*, apparently originating in the organ itself. Their action is limited to the skin and is doubtless influenced by the general health.

External Causes.—It is to be remembered that various agents acting upon the skin from without are harmless in themselves but may excite pathologic processes if conditions are favorable, *i. e.*, if the skin is rendered sensitive, or infective organisms find ready access. The external factor may then be regarded as contributory, and the exciting causes may be combinations of external, internal, and local factors.

Household pets, especially cats and dogs, are the source of many dermatoses, the most common being ringworm and impetigo. Barber shops and beauty parlors are places where these diseases are contracted, and others such as sycosis vulgaris, molluscum contagiosum, and pityriasis sicca.

Personal Hygiene.—Bathing overdone, excessive use of soap and water, as well as their too infrequent use, may be an indirect causative or an aggravating factor. Overfeeding, the texture of clothing, or too heavy clothing, especially in the case of infants, irritation from dye in garments worn next to the skin may be possible causes of mild dermatitis, pruritus, or eczema. Lack of bathing is especially an etiologic factor in parasitic disease such as ringworm, scabies and pediculosis, leading to ready transmission. Sweat saturation and accumulation of sebaceous secretion render the integument a more or less suitable soil for the growth of micro-organisms.

Local Irritants.—Due to its exposed position and its protective function, the skin is liable to trauma from variations in temperature, the effects of light, chemical and other toxic substances, from contamination by parasites and invasion, by bacteria.

Physical Agents.—The degree of injury to the skin by physical agents varies widely, severe effects producing gangrene, scars, or keloids. Scratching, rubbing, and picking are common forms of trauma. The rupture of the stratum corneum, perhaps a superficial scratch, may be all that is necessary to enable micro-organisms to penetrate to the deeper layers, with resulting dermatitis, for on injured skin a saprophytic organism may become harmful. Rubbing may aggravate itching and if continued persistently may result in lichenification. Trauma may be due to bites of insects, such as fleas and bed-bugs, of dogs, cats, and serpents, and to stings of wasps and jelly-fish, often introducing a toxic agent. Accidental cuts and bruises are of common occurrence.

Excessive exposure to *heat* and *cold* gives rise to certain affections. Heat at first may cause only a transient reddening, but if prolonged may result in burns or in telangiectasia. Profuse sweating incited by continued exposure to heat may produce hydrocystoma. Chilblains and frost-bite are caused by cold. Exposure to cold or strong sunlight may precede the onset of lupus erythematosus.

Sunlight produces an acute inflammation or, in the course of years, chronic actinic dermatitis. Protracted exposure may induce a protective reaction on the part of the pigment of the skin, such as tanning and freckles. Similar effects may be the result of incautious exposure to *ultraviolet light.*

Duke has suggested the term "physical allergy" for altered reaction caused specifically by the action of physical agents such as light, heat, cold, and mechanical irritation, and in the case of heat sensitiveness, indirectly by the effect of mental or physical exertion. There appear to be two distinct varieties of physical allergy: in one type the reaction is confined to the skin directly exposed to the physical agent (called contact reaction). In the second type the reaction may involve not only the skin areas directly exposed but distant tissues as well, called reflex-like reaction, or only distant structures. In the contact type of case the symptoms consist of erythema, pruritus, and edema of the skin, which almost always appear on suitable exposure of the skin to the agent to which the patient reacts. More intense exposures or delayed reactions lead to a dermatitis. After an exceedingly slight exposure, solitary reactions may occur in the form of wheals and papules over limited areas.

There are two explanations suggested by Duke, one based upon the assumption that patients with allergic tendencies might become specifically hypersensitive to some new body formed in the tissues solely under the influence of one specific physical agent; the other that under abnormal conditions a protein molecule might be broken down under the influence of a physical agent, with the liberation of a histamin-like body, and that this causes the reaction.

The actual cautery, the electric spark, x-rays and radium may produce burns of various kinds.

Chemical Agents.—Among other local irritants causing dermatitis are chemical agents, and those of vegetable and mineral origin. Some chemicals, such as phenol, are so caustic and harsh as to produce an inflammation almost invariably, while others only occasionally give rise to irritation in certain persons who have a peculiar susceptibility or idiosyncrasy toward them. Such hypersensitiveness may exist from the time of birth or be formed from a previous exposure, or from prolonged or frequent contact to the substance. Consequently, although the first exposure to a particular irritant may result in a dermatitis, it often does not occur until there has been contact protracted over several years. If a dermatitis has once been provoked by the action of a local irritant, the slightest contact with minute traces subsequently may cause a reaction. Persons can become hypersensitive to a large variety of substances and react whenever they come in contact with them. Cutaneous hypersensitivity may be localized to certain areas which alone react to the sensitizing substance.

The group of occupational diseases or industrial dermatoses, which is considered more fully in Chapter XII, is only touched upon here. These are numerous and varied, due to the wide range of dyes and chemicals used in industry. Dust of certain woods or dust containing mineral particles may be the responsible factor. The handling of flour, paint, varnish, bricks, mortar, clay, poisonous plants and other vegetable substances, as croton oil and wool, may give rise to an erythema or dermatitis. Photographers, electrotypers and foundrymen may suffer from dermatitis as a result of the nature of their work.

Parasites.—Among the cutaneous diseases of animal parasitic origin those of most common occurrence are scabies and pediculosis. Vegetable parasites are responsible for a considerable number of disorders of the skin and its appendages as ringworm and favus (Hyphomycetes, especially Trichophyton and Microsporon), actinomycosis (Streptothrices), blastomycosis (Blastomycetes), sporotrichosis (Sporotrichum), and moniliasis.

Bacteria.—Of the micro-organisms causing dermatoses, bacteria play by far the chief rôle. However, there is still uncertainty regarding the exact pathogenesis of numerous diseases to which bacterial origin has been assigned.

Almost any micro-organism is likely to be found on the skin. Some exist as harmless saprophytes, but they may, as has been said, become pathogenic. Cutaneous affections due to pathogenic cocci are numerous, among which may be mentioned sycosis, acne vulgaris, furuncles, and carbuncles caused by staphylococci; erysipelas, ecthyma, and lymphangitis by streptococci, and impetigo by both. The rôle of cocci in skin diseases seems of ever increasing importance, and it now appears probable that many cases which have been called eczema result from sensitization to them or their products. The tubercle bacillus, the lepra bacillus, and the Ducrey bacillus are the specific causative agents of tuberculosis cutis, leprosy, and chancroid. Of diseases due to spirilla the most important to the dermatologist because of its prevalence, its resistant character, and many clinical manifestations, is syphilis, caused by the *Treponema pallidum,* otherwise known as the *Spirochaeta pallida.*

In syphilis we have a cutaneous disease most dangerous from the point of view of *transmission.* Fungus diseases, impetigo, furunculosis, the anatomical wart—a form of tuberculosis—acute eruptive fevers, as well as syphilis, may be transmitted by actual contact directly with the infected person or indirectly with a contaminated object, such as a glass, towel, or garment. Ingestion of infected food may be the mode of transmission as in tuberculosis or scarlet fever. Deposition of pathogenic micro-organisms in the skin by insect carriers may give rise to certain diseases with cutaneous manifestations as in Rocky Mountain spotted fever and typhus.

Exposed persons occasionally show surprising resistance to infection. This may be due to a failure of the micro-organisms to penetrate the stratum corneum or to proliferate, or due to antibodies in the local tissues or in the blood stream.

Internal Causes.—*Systemic Disease.*—That a large number of affections are not clinical entities, but are expressions on the skin of a constitutional disease is well known today. Certain eruptions, as for instance in syphilis, may be regarded as a phase of a systemic disease rather than as a skin entity. Attention is again directed to the fact that the same type of lesions may originate from any one of a number of pathologic disorders of an internal organ. The same derangement may not always give rise to the same cutaneous manifestations. The same individual may react to various causes in approximately the same way, whereas others sometimes react differently to the same cause. The type of allergy possessed by an individual may determine his particular reaction.

Metabolic disturbances are associated with disorders of the skin. Such affections as furuncle, carbuncle, folliculitis, eczema, genital pruritus, and xanthoma diabeticorum occur frequently in patients with diabetes. In seborrheic dermatitis, acne vulgaris, and rosacea and some cases of eczema and dermatophytosis there is a tendency toward a high blood sugar, a carbohydrate indigestion, hyperacidity, an alimentary hyperglycemia, and acid stools.[1] It must be added, however, that the kind of lesion and its severity do not indicate the violence of the metabolic disturbance connected with it. Some cutaneous affections occur in association with a disturbance of the kidney function, as nitrogen retention may occur in psoriasis, eczema, urticaria, and pruritus. Constipation, overeating, and lack of exercise predispose the skin to irritation and disease. It is commonly appreciated that digestive disturbance, intestinal putrefaction, and fermentation are also important etiologic factors.

Attention to disturbances of the heart[2] and blood vessels is at times demanded in a number of chronic or recurrent skin affections, the efficacy of cutaneous therapeusis depending largely on correction or amelioration of such disorders. Anemia and other defective conditions of the blood may be a causative factor or act as a deterrent to the clearing up of cutaneous affections.

The central or peripheral nervous system has an influence upon the distribution of eruptions as well as a direct causal effect. Among the various affections in which the nervous system seems to play a part may be included pruritus, hyperidrosis, glossy skin, some cases of alopecia areata, Raynaud's disease, scleroderma, dermatitis herpetiformis, and pemphigus. In only a few have degenerative changes in the nerve tissue been noted. Trophic disturbances are produced by leprous neuritis. In herpes zoster there is an inflammation in one or two posterior root ganglia. Lesions in the spinal cord occur in pemphigus. Lichen planus is regarded as being connected in a vague way with some disorder of the central nervous system. Eruptions following operations also point to nervous origin.

The sympathetic nervous system has some influence on diseases of the skin, but as yet this is not well understood. Vasomotor conditions belong in this category.

Cutaneous lesions resulting from overwork, worry, and severe shock or other emotional upset are not always traced to the responsible source. Cases of transient erythemas involving the face, neck, trunk, arms, extensor surfaces of the thighs, urticaria, and neurodermatitis may be due to emotional disturbances.[1] Rosacea, genital pruritus, and other affections may be aggravated by disturbances of the nervous system. Eruptions are sometimes caused by picking or scratching, habits of nervous origin.

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[1] Combs, F. C.: Some Skin Manifestations of Systemic Disease, Med. J. and Record, 127: 659–663, June 20, 1928.

[2] Walsh, David: Chronic and Recurrent Maladies of the Skin in Relation to Heart Disease, Brit. M. J., 2: 304–306, Aug. 10, 1912.

In the obscure field of endocrinology, we find expressions of glandular dysfunction in the skin more than in any other organ. Some skin diseases probably are affected by the various organs of internal secretion, the thyroid, thymus, adrenals, ovaries, *et cetera,* which as a system may interact upon one another inharmoniously or may fail in their assigned function in regulating metabolism and blood pressure. The etiologic relation between disturbances of the internal secretory glands and disease of the skin is illustrated by myxedema, chloasma, and the pigmentation of Addison's disease. Irradiation of the thymus as a therapeutic measure attended with some success in psoriasis suggests an endocrine relationship. Some cases of acne, urticaria, angioneurotic edema, hypertrichosis, and impetigo herpetiformis are among the cutaneous diseases suspected of having their origin in this system. Pregnancy and lactation are occasionally contributory factors, eruptions of eczema, psoriasis, and dermatitis herpetiformis being of relatively frequent occurrence. Acanthosis nigricans (adult type) may be associated with a disturbance of the chromaffin system, which is often secondary to involvement of the adrenal glands or neighboring structures by malignant tumors.

Toxins.—Foodstuffs, drugs, or toxins set free by micro-organisms, or antibodies produced in the blood or in tissues sometimes give rise to skin eruptions. Toxins formed by bacteria either are eliminated by the microorganisms themselves (exotoxins) or result from action of the bacteria on the tissues or from a splitting up of the bacterial proteins during their disintegration (endotoxins). The effect of toxic substances may also be conveyed indirectly through the cutaneous nerve fibers, as in the action of opium, which causes itching and prickling of the skin. Among the various forms of dermatitis produced by toxins the most common are erythematous blotches and wheals (erythema multiforme and urticaria), rashes similar to the exanthemata, and less frequently vesicular and even granulomatous eruptions. It is often a tedious and difficult process to locate the exact toxic agent which is responsible, and sometimes it is impossible.

Toxins from foodstuffs may be products developed spontaneously in the gastro-intestinal tract due to digestive impairment or imperfect metabolism. This toxic process with the derangements involved is known as autointoxication. Such foods as clams, oysters, crabs, lobsters, mushrooms, strawberries, and pork may undergo rapid changes and deterioration, giving rise to toxic products in individuals who can usually take them without suffering any disorder. While there are foodstuffs that are likely to be deleterious and cause dermatitis in any one, there are various harmless ones as cheese, eggs, buckwheat, and oatmeal to which only a few persons are sensitive, and milk to which some infants react unfavorably. This latter condition known as anaphylaxis or hypersensitiveness is permanent, and not occasional and transient. It is not limited to foods but in different subjects applies to foreign proteins and serums. Hypersensitiveness to various substances is recognized as an important etiologic factor in several dermatoses. It has been found that a predisposition to hypersensitiveness is frequently inherited. However, according to Cook and Vander Veer,[1] the specific form of sensitization is acquired in the course of life by contact; consequently this susceptibility in offspring is often to different substances than those to which the parents reacted. A derangement in the functioning of the vegetative nervous system is apparently involved.

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[1] Hazen, H. H., and Whitmore, E. R.: Skin Diseases Due to Emotional Disturbances, Arch. Dermat. and Syph., 12: 261–266, Aug., 1925.

The terms anaphylaxis and allergy originally came into use through observations made following serum injections. Richet employed anaphylaxis to describe reactions noted in animals after a second injection of substances that in the first injection were without ill-effect. Pirquet called the altered reactivity of patients injected with serum "allergy."[2] Bloch has produced evidence that various forms of clinical hypersensitiveness produced by animal, vegetable, and mineral substances, and by ingested drugs are all examples of antigen-antibody reactions. Many manifestations of idiosyncratic dermatoses (urticaria, angioneurotic edema, toxicoderma, drug eruptions and their closely related diseases, asthma, hay fever, and serum sickness) represent allergic reactions, *i. e.*, they are caused by the contact of an antigen with its own specific cellular fixed antibody. In a great number of individual cases, the existence of specific antibodies has been demonstrated by the method of Prausnitz and Küstner—by the local transfer of hypersensitiveness. Bloch, experimenting on himself with primula, succeeded in producing a hypersensitivity by passive transfer, and he and Karrer proved that a pure crystalline substance obtained from primula plants has the, or one of the, idiosyncratic properties of the primrose. Even a minute quantity of this substance ($C_4H_{20}O_3$) produces a violent eczema, so that a type of anaphylaxis can apparently be caused by a simple nitrogen-free substance. By analogy he has reached the same conclusion of an allergic basis regarding other forms of eczema. Whether or not a person has one of these idiosyncratic diseases depends upon (1) exposure to antigenic substance, and (2) the capacity of a given organ to produce specific antibodies. In this second factor lies the personal and often constitutionally hereditary character of the idiosyncrasy. The origin of the causative agent in the vast majority of cases is extracellular. Each of these cutaneous manifestations and allied diseases, or combinations of them, can be produced by innumerable and most varied agents; or the same substance may be responsible for these different pathologic conditions. They occur relatively frequently in the same person or in members of the same family. As Ormsby says, true anaphylaxis is difficult to prove in some types of hypersensitiveness.

Hypersensitiveness also applies to drugs. This does not mean that all drug eruptions are due to the allergic mechanism. Even minute quantities of certain drugs the ingestion of which is without harmful effects on most individuals, can cause an eruption in a susceptible person. The drugs capable of such influence in allergic subjects are numerous, those most frequently harmful being the bromides, iodides, coal tar analgesics, and hypnotics, phenolphthalein, quinine, and arsenic. The nature of the reaction to drugs is still undecided. This hypersensitiveness to a drug is usually a stable condition, which cannot be overcome by the injection of small amounts of the sensitizing substance, as is possible in some other forms.

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[1] Cook, R. A., and Vander Veer, A.: Human Sensitization, J. Immunol. 1: 213–215, June, 1916.

[2] "Allergy is that state which has as its basis the property of certain groups of cells (organs) of the living organism to react in a specific manner when brought in contact with a substance which is, as far as is known, foreign to the organ or cells; the characteristic of this specific pathologic process lies in the fact that it is caused by the reaction of this exogenous substance with its specific cellular fixed antibody. The basis and the essence of allergy is the ability of the living cell to react with the production of specific antibodies to the stimulus of foreign substances, which are therefore called antigens, as well as the fact that the contact of the antigen with its specific cellular fixed antibody causes a disturbance of cellular life which usually results in an inflammatory reaction." Bloch, B.: The Rôle of Idiosyncrasy and Allergy in Dermatology, Arch. Dermat. and Syph., 19: 175–197, Feb., 1929.

Focal Infections.—Focal infections in the teeth, tonsils, sinuses, appendix, gallbladder, or genito-urinary tract are causative factors in cutaneous maladies. The pustular type of rosacea is often produced by sinusitis. Some severe cases of acne are cured only by removal of diseased tonsils or appendix. Urticaria and erythema multiforme may have these underlying causes or be produced by infected teeth, colitis, cystitis, or endocervicitis.

PATHOLOGY

General Skin Pathology

Because of its position the skin is exposed to many forms of irritation, such as physical agents, the weather, chemicals, and bacterial infection. Physiologically, the close relationship of the skin with the nervous system, the heart, kidneys, gastro-intestinal tract, and the endocrine glands also renders it susceptible to various internal derangements, so that cutaneous disorders from these sources are numerous.

The pathologic processes which involve the skin are similar to those occurring in other portions of the body. The local action may begin in some particular stratum as in the epidermis, the corium, especially the papillary layer, in the glandular structures, or the deeper tissues. The exact point of origin is of assistance in reaching a diagnosis. The hair and nails may undergo certain alterations. The origin may also be in a particular constituent, as in the cells themselves, or other tissue components, in the cutaneous nerves or in the vessels, and the supply or composition of the blood or lymph. Moreover, the morphology of the lesions is influenced by differences in the anatomical structure of the skin in various locations.

As stated, the skin is subject to all the pathologic alterations observed in other organs: Hyperemias, hemorrhages, inflammations, hypertrophies, atrophies, neoplasms, *et cetera.* Anemia, hyperemia, and edema are usually circumscribed or diffuse manifestations of functional disturbances of the cutaneous vascular system, arising from a variety of causes, whereas hemorrhages and telangiectases are likely to depend upon organic changes in the vessel walls.

Hypertrophy, characterized by increase in the mass of a tissue either by an increase in the number or size of tissue elements, is of manifold kinds and varies according to the elements, or the combination of elements, involved. Many hypertrophies are of congenital origin. Pseudohypertrophy, which is an increase in mass by an additional number of tissue elements of a degenerative type, is encountered chiefly in malignant neoplasms.

In atrophy of the skin there is diminution in the size of the single elements resulting from degeneration of the cells, or a decrease in the number of single elements. The two forms frequently appear combined, sometimes the first and sometimes the second predominating. On the basis of insufficient assimilation in the cells, and the factors which prevent intake of food, Gans distinguishes six types of atrophy: (1) Physiologic atrophies, as senile atrophy; (2) inanition atrophies; (3) inactive atrophies; (4) atrophies through mechanical causes as pressure and pull; (5) so-called neurotic atrophies, and (6) atrophies after toxic processes.

Dystrophy, due to interference with the nutrition of a tissue leading to pathologic changes in it, is a common alteration which may affect any part of the skin.

Inflammatory processes of the skin may be divided into those which are superficial, involving chiefly the epidermis and papillary bodies, or deep, involving the cutis and subcutaneous tissue. Occasionally several layers are invaded, but generally one is attacked secondarily to the other. The appendages may also be involved as part of the general process, or separately, by affections peculiar to them. Pathologic changes may be merely minor alterations in the appearance and texture of the skin, or mechanical loosening of its parts—erosions and excoriations—or may be profound disorders with extensive tissue effects.

Changes due to mechanical irritation are frequent, and originate promptly and progress rapidly; their intensity being influenced by the topography. Where the horny layer is thick and the subcutaneous adipose tissue is firm, the reaction to trauma is less than in parts having loose areolar tissue and marked vascularity. Gans has found a decided increase of epithelial mitoses occurring after a comparatively slight interference, with a friction of three to six minutes. Under stronger traumas, where some necrosis occurs and reparative processes are necessary, there are profound inflammatory manifestations. In the so-called intertrigos which are to be traced to mechanical influences, we are dealing with decomposing secretions and macerations of the skin, but also with ever-present epidermic parasites, whose significance has been frequently overestimated.

Nevertheless, experience of recent years has increasingly shown in what measure locally active micro-organisms are responsible in these conditions. By the discovery of new infectious agents and the recognition of the infectious nature of diseases, the number of diseases belonging to this group is constantly growing. On normal skin some bacteria generally lead a harmless existence, but under different conditions may proliferate actively, or increase in virulence and become pathogenic. Other micro-organisms, pathogenic, or nonpathogenic, may be accidentally deposited on the surface. It is commonly held that pyogenic staphylococci are almost constant habitants of the human skin, and, therefore, pyodermic conditions are due primarily to some lowering of the patient's local or general resistance, as by anemia, glycosuria, trauma, and the like. Extensive research into this matter by Michael, Smith, and others has declared against the ubiquity of staphylococci, and it follows that in cases of recurrent pyogenic infection of the skin, such as furunculosis, surface antisepsis is of great importance. These investigations were made by cultures of the saline washings of the hands of healthy persons and of those suffering from some suppurating lesion. Smith cultured washings from the hands of 150 persons, of whom 80 had some pyogenic inflammation, or moist dermatitis, and 70 had unbroken, not obviously infected skin. There were 225 strains which were isolated and studied. This small number of strains is in itself noteworthy; it was not uncommon to find all the colonies from a case identical, and two or, at most, three strains were the rule. Of 80 cases with pyodermia about 75 per cent yielded cocci and 25 per cent did not; of 70 cases with sound skin 55, or about 80 per cent, yielded no cocci, although they were present in about 21 per cent. These figures illustrate the strong contrasts between the two groups. It will thus be seen that apart from the existence of a frankly infective dermatosis or close association with a person so affected, the presence of staphylococci on the skin of the hands is less common than has been generally believed. There seem to be no essential differences between the aureus, albus, and citreus varieties, and alterations of pigment in the same strain of cocci have not infrequently been observed. Hemolytic staphylococci seem of greater virulence and of a more specifically pathogenic character than the nonhemolytic cocci.

The epidermophytons and various yeasts and molds are found in the folds of many normal skins, and saprophytic bacteria, spore-forming organisms, and diphtheroid bacilli are often encountered. In disease, the skin flora is changed by the presence of the infective organism and secondary contaminants which find favorable nutriment in the exudates upon the skin. As a rule, the stratum corneum does not offer a suitable soil for the growth of bacteria, but when the surface is rendered more favorable by moisture, excessive secretion of fat, *et cetera*, they may multiply and attack the host. Micro-organisms are found in largest numbers in regions where friction is slight, as between the fingers and toes, the axillae, and in the creases of the groins and genitalia, and where the large sebaceous glands are located. A preexisting dermatitis or an abrasion or other surface disruption may locally lower the resistance of the skin to such attacks. Factors such as the region attacked and its natural sensitivity, the age and general health of the individual also influence the power of resistance to direct surface access, and likewise to pathogenic micro-organisms carried to the body surface by the blood stream.

Organisms may thrive best in one or another layer of the skin. In many infectious dermatoses the causative agent is found in the corium. Although in the majority of cases the infection enters through the epidermis, the organism finds its proper soil in the cutis, and there first produces changes characteristic of the disease. Of this type are erysipelas, furunculosis, carbunculosis, syphilis, and tuberculosis cutis.

Inflammations produced by chemicals applied externally, more emphatically than in any other group, bring to our attention the fact that similar clinical manifestations may be due to completely different causes, as well as that completely different morbid manifestations of the skin may be due to the same cause. This is also true for the eruptions produced by the internal administration of drugs, and by bacterial toxins.

The pathologic processes primarily involving the epidermis and those in which the corium is the site of origin are separately considered, as these features have diagnostic importance.

Epidermis.—The pathologic processes primarily involving the epidermis may be congenital, as in ichthyosis (general) and keratoma palmare et plantare (local), or acquired and limited as in callus and cutaneous horns, or diffuse as in pityriasis rubra pilaris. The epidermis may undergo hypertrophy either as a whole or in one of its component layers. Hypertrophy of the *stratum corneum* known as *hyperkeratosis* is a common pathologic condition, being diffuse or localized and being divided into primary and secondary types. In the essential hyperkeratoses, hereditary disposition plays a rôle. Among the secondary hyperkeratoses are included all those which are due to pressure or irritation, or are sequelae of other dermatoses. As the ectoderm is the common basis from which the changes proceed, disturbances of the appendages

—the hair and nails—parallel those of the skin. The basal or germinal layer produces, increased numbers of daughter cells, which undergo abnormally rapid cornification, with the formation of a firm horny mass. In angiokeratoma the increase in the horny layer is associated with vascular changes. Frequently in keratosis of the palms and soles there is likewise hyperidrosis. Hyperkeratosis may also occur about the orifices of the sweat glands in association with the elimination of a drug (as arsenical keratosis).

In a variety of affections of the skin, principally inflammatory in character, there are an increased number of horn cells and imperfect cornification, designated *parakeratosis.* The horn cells are swollen and moist, and retain their nuclei; there is incomplete formation or absence of keratin so that the cells are loosely attached to each other, allowing small collections of leukocytes and serum to filter between them. Masses of these cells form scales, which readily desquamate. This change in the stratum corneum is always preceded by edema in the rete mucosum and is observed in eczema, psoriasis, seborrheic dermatitis, and other affections with scaling, as well as in the desquamating stage of acute fevers.

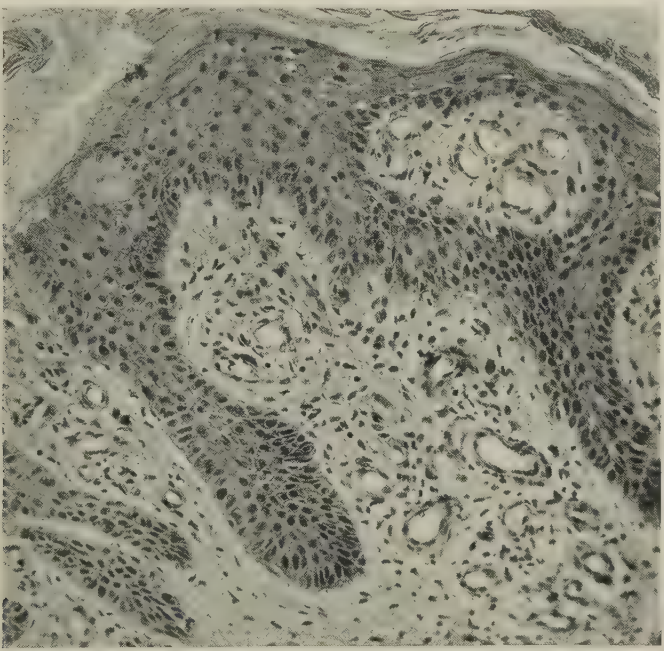

Fig. 3.—Hyperplasia in margins of varicose ulcer of leg, nonmalignant. (Courtesy of Dr. Leila C. Knox.)

Dyskeratosis is a term applied to anomalous forms of imperfect cornification, as previously mentioned, in which some of the Malpighian cells undergo a premature and abnormal keratinization. Dyskeratotic cells are found in many skin diseases, including molluscum contagiosum, carcinoma, Paget's disease of the nipple, and keratosis follicularis (Darier's disease). Similar changes of a milder degree are observed in many histologic sections which show acanthosis.

Changes in the *prickle-cell layer* occur in almost every form of dermatitis.

In a large number of inflammatory affections, such as eczema, herpes, and eruptions due to chemical irritants and plants, edema of the rete in and between the cells takes place. When profuse it frequently leads to vesiculation and bulla formation. Examples of the intercellular type of vesiculation are herpes zoster and dermatitis herpetiformis; of the intracellular type, are varicella and variola. In the blisters found in dermatitis herpetiformis and pemphigus, the serum contains a considerable number of eosinophils. Severe degrees of these edematous changes produce a spongy condition of the rete.

Hypertrophy of the prickle-cell layer is called *acanthosis* and takes place as both a benign and a malignant process. In the former, a true hypertrophy, the prickle cells increase in number while retaining their intercellular fibrils; in the latter, a pseudohypertrophy, the cells in the overgrowth lose their fibrils, becoming disconnected, shrunken, and showing other defects of degeneration. In the latter condition, the sharp boundary between the epidermis and the corium is broken up by the proliferation of the degenerated cells from above and by leukocytes from the corium below.

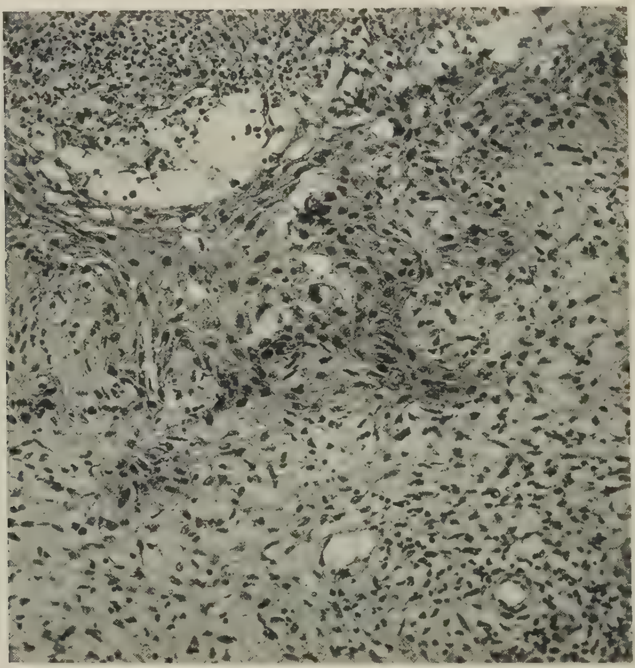

Fig. 4.—Regeneration of epithelium in base of healing ulcer of leg, nonmalignant. (Courtesy of Dr. Leila C. Knox.)

At the edge of chronic ulcers the acanthosis may result in such extensive downgrowth of rete pegs as to simulate the histologic picture of epithelioma, as shown in Fig. 3. At the base of such an ulcer the regenerating epithelial cells may invade the granulation tissue in irregular masses as shown in Fig. 4.

Hypertrophies of the prickle-cell layer may be circumscribed as in warts and condylomata, or cover extensive areas as in lichenification, and may occur as a congenital affection as in soft nevi. *Lichenification* is a leathery change which takes place in the skin as the result of long-continued rubbing. It is characterized by an exaggeration of the normal markings of the skin, so that the striae form a criss-cross pattern between them, being composed of flat-topped, glossy, smooth, quadrilateral facets. Lichenification is associated with severe itching. Widespread diffuse hypertrophy of the prickle-cell layer, or acanthosis, frequently occurs in dermatoses, examples being eczema and psoriasis. Cocci on the skin surface may lead to acanthosis, as evidenced by dermatitis vegetans, and by vegetative processes superimposed on the lesions of syphilis and other diseases. In many affections having their origin in the corium, such as tuberculosis, syphilis, and leprosy, there is an extensive overgrowth of the prickle-cell layer.

In atrophy of the skin the epidermis is thinned and there is a diminished formation of keratin. In the rete, the interpapillary prolongations are much shortened, so that the wavy line between it and the corium is straightened out; the rete becomes thinned and its cells shrunken. This condition may occur as the result of external or internal pressure, or be a part of a general atrophy of the epidermis and corium, and it is frequently an accompaniment of advancing years. A general atrophic condition of the skin may be associated with malnutrition or chronic wasting disease. A defect in the nerve supply to a certain area may result in local atrophy. Idiopathic atrophy of the skin affects all layers, its etiology being undetermined.

Corium.—Inflammation as a process in the skin does not vary from the classical concepts of general pathology except as modified by local structural characteristics. The pathologic alterations are numberless but, for clarity, are in general divided, according to the nature of the cellular infiltration, into simple inflammations—acute or chronic—granulomata and neoplasms.

The simple inflammatory conditions are characterized by a perivascular infiltration of leukocytes. This is greatest about the pilosebaceous apparatus and the sweat glands, which have a liberal blood supply and offer favorable portals for the entry of infection. The infiltration in acute inflammations is usually composed of polymorphonuclear cells, whereas in the chronic stages lymphocytes predominate, but aside from the duration of the inflammation, the relative numbers of these cells are influenced by the cause of the inflammation and peculiarities of the individual. The leukocytic infiltration is augmented by the proliferation of fixed connective tissue cells, chiefly *fibroblasts*. These are small, young, oval cells with vacuolated nuclei. There is considerable difference of opinion concerning their nature and genesis. Occasionally mast cells, and others of connective tissue origin, are also observed.

The cellular infiltrations characteristic of a limited number of slowly progressive, persistent diseases of relatively slight virulence, consist of plasma cells, epithelioid cells, multinucleated cells (chorioplaques), and giant cells. *Plasma cells* are rounded or cuboidal cells, about twice the size of a leukocyte, with large round nuclei eccentrically placed containing several deeply staining granules of chromatin. *Giant cells*, described by Langerhans, occur in the corium in cutaneous tuberculosis so frequently as to be almost pathognomonic of this disease. They are irregular in shape with a degenerated protoplasmic center encircled peripherally by multiple nuclei. Other forms of this cell type in which the nuclei are centrally located are known as chorioplaques.

This type of tissue reaction occurs in lesions known as *granulomata*, and is usually associated with proliferative or degenerative changes in the connective tissue. Nonspecific granulomata may arise upon the mucous membranes as the result of chronic mechanical or chemical irritation, from ill-fitting dentures and purulent exudates. The specific infectious agents of most diseases that produce granulomatous lesions are known, and such diseases—syphilis, leprosy, tuberculosis, mycotic granulomata, yaws, and granuloma inguinale—are known as the infectious granulomata. Histologically, certain distinctive attributes appear in the lesions of several of these diseases which assist in differentiating them—syphilis by a panarteritis of the deeper vessels, by a perivascular mantle of plasma cells, by a relative sparsity of epithelioid cells and giant cells, and by a proliferation of the connective tissue elements; leprosy by the vacuolated epithelioid cells known as the "lepra cells"; tuberculosis cutis by the formation of tubercles consisting of central giant cells or epithelioid cells, surrounded by lymphocytes and fibroblasts; mycotic granulomata by multiple sinuses and abscesses in addition to the infiltration of plasma cells, epithelioid cells, polymorphonuclear leukocytes and fibroblasts; and granuloma inguinale by the dense infiltration of plasma cells and by marked connective tissue degeneration.

Neoplasms, primary in the corium, are characterized by cellular infiltrations that conform to the cells of origin or their lineage. In fibroma there are small spindle-shaped connective tissue cells with oval or fusiform nuclei. In sarcoma the cells are usually spindle shaped, being the same as those of embryonic connective tissue. Other forms of sarcoma are rare in the skin. The cells of carcinoma of the skin resemble either those of the basal-cell or prickle-cell layers of the epidermis, although intermediary and mixed forms are common. About the invading edge of most malignant tumors there is found a tissue reaction consisting of plasma cells, connective tissue cells, and leukocytes.

Degenerative changes in the cells of the corium are of four principal types —fatty, hyaline, mucoid, and edematous. Degeneration of the collagen is first demonstrated by a loss of its affinity for acid aniline dyes, becoming basophilic. The fibers disintegrate into lumps and granules. The degeneration may also be colloid, mucoid, or hyaline. Elastin is more resistant to toxic action than collagen, but also degenerates, forming elacin, which likewise is basophilic. In atrophic skin, the elastic fibers show marked changes, and fatty or calcareous deposits may occur. Both the elastin and collagen disappear in areas of dense cellular infiltration about sacroma and carcinoma.

Other Changes.—The skin is richly supplied with *blood vessels,* which have well developed walls and are liberally surrounded by elastic fibers. Consequently, the amount of blood in the skin varies widely within physiologic limits. When the skin is injured by scratching or by extreme heat, freezing or other physical agents the cutaneous vessels dilate locally. Vascular obliteration, due to disease or mechanical cause, usually leads to atrophy of the part supplied by the particular vessels. The budding of solid cords of cells from the walls of the vessels, later become hollow, and a dilatation of the vessels result in the formation of hemangiomas. New formation of capillaries or acquired dilatations known as telangiectases may occur from any local or general condition which produces protracted passive congestion.

When the skin is injured by scratching with the point of a needle, by the application of heat, by freezing, and by a variety of other physical agents, the vascular reaction is threefold. Locally the vessels dilate, the skin shows wheals or blisters, and the surrounding area becomes a bright red flare. The first two reactions are now known to be independent of the nerve supply of the skin; the third is considered a reflex action, depending upon the integrity of the cutaneous nerves themselves. The familiar reddening of the skin, induced by cold, occurs equally well after the cutaneous nerves have degenerated, and the contraction of the minute vessels in response to gentle stroking, and always following the application of adrenalin or pituitary extract, is unaffected by *nerve degeneration.*[1]

Alterations in the circulating blood are found in several skin diseases. A secondary anemia is common during the exanthematic stage of syphilis, in leprosy, and in affections due to the pyogenic cocci.

Patients with generalized recurrent dermatoses which have been repeatedly treated by *x*-rays over a number of years, or physicians extensively employing *x*-rays or radium are likely to have moderate degrees of aplastic anemia. Without irradiation, these changes are also observed in the late stages of mycosis fungoides, leukemia, and malignant tumors. There is a leukocytosis in those diseases accompanied by fever, being especially marked in erysipelas and scarlatina. In erythema multiforme, dermatitis medicamentosa, scabies, creeping eruption, and dermatitis herpetiformis there is eosinophilia, which may also be present in severe irritation of the skin from other causes.

Alterations in the blood chemistry occur in many patients with cutaneous affections. An increase of cholesterin is frequent in xanthoma, and the blood sugar content may likewise be high, as is sometimes the case in pruritus, eczema, and lichen planus. Increase of urea, uric acid, creatinine, and chlorides in the blood is associated with pruritus and eczema accompanying chronic nephritis. The nitrogenous products are also often present in excessive quantities in psoriasis. The bilirubin content may be abnormally high in generalized pruritus even though icterus is not evident. There are numerous reports in the literature concerning changes in the blood chemistry in many other diseases of the skin, but they are too indefinite and irregular to be of practical importance.

Lymphatic vessels in the skin may be ectatic, or lymphatic new growths may form as in nevi, leukemia, and lymphoid tumors. Cystic lesions may occur, which are dilated lymphatics lined with endothelium.

Injury to peripheral *nerves* may be accompanied by atrophic changes and glossiness in the skin, or with vesicle, bulla or ulcer formation. Rarely small tumors or neuromas are produced by a proliferation of nerve tissue, consisting of ganglion cells and nerve fibrils supported by connective tissue stroma. New growths from the interstitial connective tissue or perineurium of a nerve, known as neurofibromas, are frequently encountered. They may form along a nerve trunk or as single or multiple isolated skin lesions.

The *muscle* bundles of the skin may undergo granular and hyaline degeneration. Such changes in senile atrophy are characterized by a spiral-like transformation of the nuclei and frequently by chromatolysis (Gans). In pressure atrophy the muscle bundles also become thinner and are often without nuclei. Tumors composed of smooth muscle cells occur most often upon regions which have a large supply of smooth musculature—the scrotum, the labia majora, and the nipples. They consist of compact bundles of smooth muscle cells running in all directions, which are supported by abundant strands of connective tissue. The blood vessels and nerves enter at the periphery, and the latter are practically absent at the center, which is the most compact part.

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[1] Lewis, T., Harris, K. E., and Grant, R. T.: Influence of Cutaneous Nerves in Various Reactions of Cutaneous Vessels, Heart, 14: 1–17, April, 1927.

The *pigment* of the skin undergoes alteration in quality and quantity in many cutaneous affections. Entire absence or a marked decrease of normal pigment is an uncommon congenital peculiarity as in albinism, or may be acquired in circumscribed areas, generally preceded by a temporary increase, as in vitiligo. Certain nevi and malignant neoplasms, such as melanocarcinoma, show a decided excess of coloring matter. Hyperpigmentation due to increased melanin is associated with many affections of the skin, such as certain forms of chronic eczema and lichen planus, or a general disease, as syphilis and Addison's disease. The lower layers of the rete Malpighii show amorphous brownish granules, especially in the basal cells and in the spaces between the epithelial cells, and the melanoblasts are filled with pigment granules. In a lesser degree the presence of pigment may be demonstrated in the papillary layer and beneath it.

Another variety of pigmentation may result from a deposit of hemosiderin and similar degeneration products of hemoglobin. Hyperpigmentation of this sort is usually of short duration and is observed after contusions and in purpura, or it may follow inflammations of long standing which are due to rubbing or to venous stasis.

A bluish or grayish *discoloration* of the skin from the deposit of metallic particles may result from the continued use of certain salts of arsenic, silver, and several other metals. Microscopically large amounts of metal are found in the epidermis and the upper part of the corium, particularly in the papillae and the intercellular spaces surrounding the arterioles.

Disturbances in the function of the *endocrine glands* are often associated with changes in the skin. These develop secondarily to alterations in the general metabolism and therefore histologic peculiarities are rare.

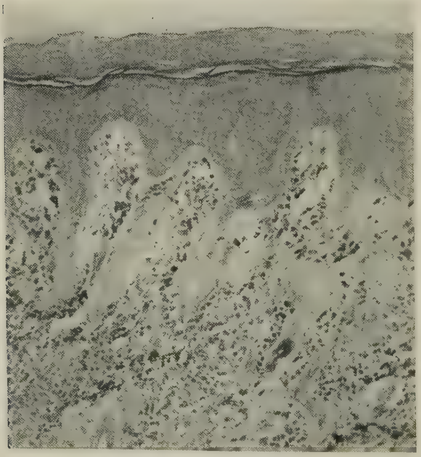

Fig. 5.—Erythema multiforme. Moderate magnification.

SPECIFIC PATHOLOGY OF COMMON SKIN DISEASES

Many common skin diseases belong pathologically in the group of simple inflammatory processes. The vast majority of these have no distinctive pathology which differentiates them from other simple inflammatory conditions, but there are a few which are recognizable under the microscope and others which cannot be diagnosed by any other means. A general description of simple inflammatory infiltration has already been given, and the main features characteristic of some common dermatoses will now be enumerated.

Erythemas, Urticaria, Erythema Multiforme, Angioneurotic Edema.—These conditions are characterized by marked dilatation of the blood vessels, by interstitial edema, and relative sparsity of cellular infiltration and epidermal changes. The cells of the infiltration are usually lymphocytes, but at times large numbers of eosinophilic polymorphonuclears are present, being especially observed in eruptions due to the ingestion of drugs. In cases of great severity, there may be epidermal changes consisting of edema and parakeratosis, and when the edema is sufficient, subepidermal or intraepidermal vesiculation, or bulla formation may occur. The contents of the blebs which are at first clear, later become purulent.

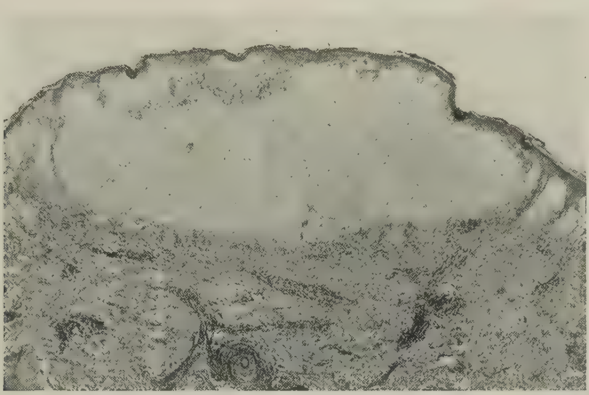

Fig. 5A.—Erythema multiforme bullosum. Section of bulla. Low power. (Courtesy of Dr. Frederick W. Birkman.)

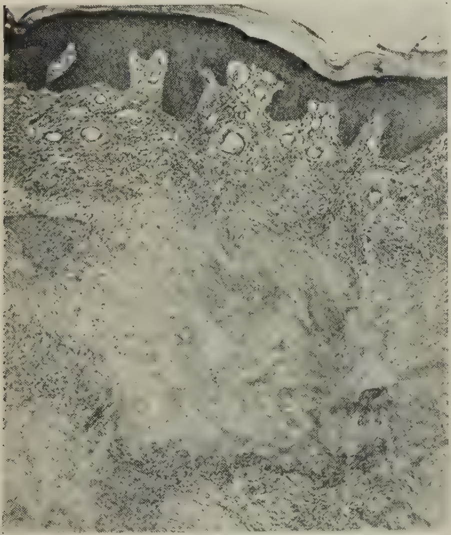

Fig. 6.—Granuloma annulare. Low power.

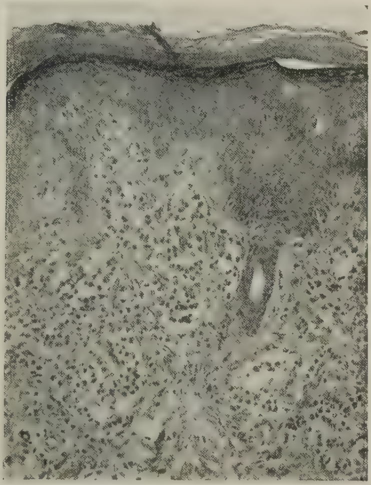

Fig. 7.—Urticaria pigmentosa showing clusters of mast cells in the upper cutis. (Courtesy of Dr. Gerald M. Machacek.)

In **granuloma annulare** there is a collection of lymphocytes, fibroblasts, and epithelioid cells which form a nodule deep in the corium. At the center of the nodule there may be some areas of necrosis. The epidermal alterations are insignificant.

The histologic changes in **urticaria pigmentosa** are characterized by the presence of mast cells in the upper corium and by an increased amount of pigment in special cells in the basal-cell layer of the epidermis and in the corium.

Eczema, Dermatitis Venenata, Occupational Dermatitis, Dermatophytosis.—The microscopical appearances of these diseases vary considerably according to the stage of the eruption, its severity, and topography. However, there is nothing distinctive to separate them microscopically from one another or from other dermatoses. In fact, the absence of any salient characteristics helps to place these diseases in one group and to separate them pathologically from other diseases which have distinctive microscopical features. In the diseases of this group the pathologic manifestations are likely to be confused by additional changes due to scratching and secondary infection. Whereas the process begins with vascular dilatation and an exudation of round cells about the vessels, other microscopical changes tend to appear as the severity and duration increase. Pronounced edema, both inter- and intra-cellular, vesicle formation in the upper part of the corium and in the epidermis, and epidermal changes, such as acanthosis, hyperkeratosis, and parakeratosis are observed. Lichenification is frequently superimposed, being due to rubbing. It is manifested by acanthosis, parakeratosis, and hyperkeratosis, and in the corium by edema, and a focal perivascular infiltration of lymphocytes and round connective tissue cells in the subpapillary zone.

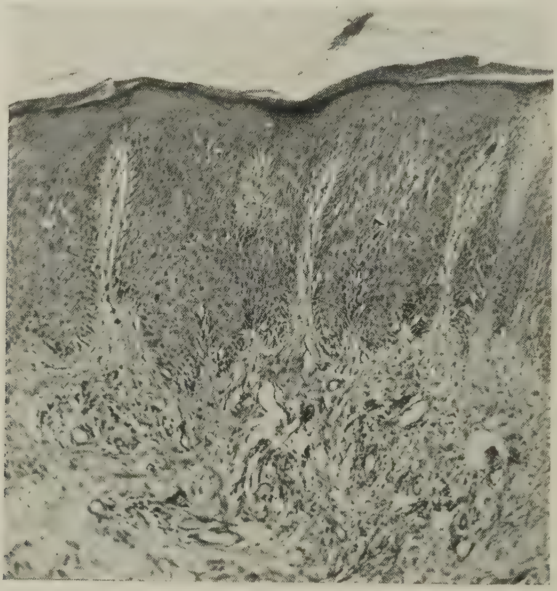

Fig. 8.—Squamous eczema.

Seborrheic Dermatitis and Pityriasis Rosea.—The changes in these affections are similar, with a tendency to edema, parakeratosis in the epidermis, and to acanthosis and elongation of the interpapillary processes. There are a moderate vascular dilatation, edema, and a lymphocytic infiltration in the upper part of the corium. In **pityriasis rosea,** at the height of the disease minute vesicles, only visible microscopically, form beneath the stratum corneum, which later exfoliates.

Pityriasis Rubra Pilaris.—In pityriasis rubra pilaris the essential microscopical feature is a papule, with hyperkeratosis of the epidermis, particularly of the upper portion of the hair follicle, leading to the formation of a horny plug. The granular layer is thickened. In the corium there are mild inflammatory changes.

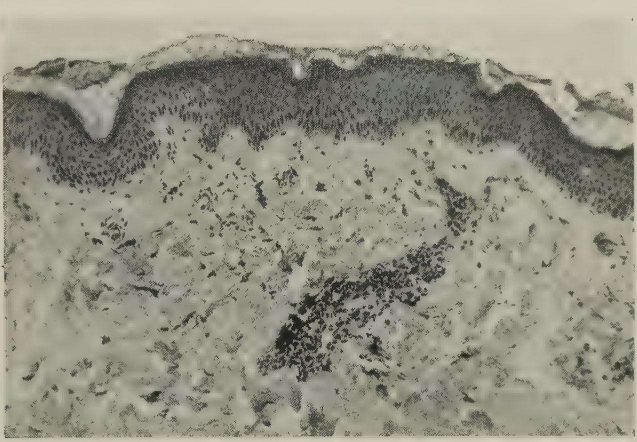

Fig. 9.—Pityriasis rosea. Low power.

Psoriasis.—The microscopical picture of this disease is usually sufficiently characteristic by itself to afford an accurate diagnosis with reasonable certainty, although it varies according to the stage of the disease and the location of the lesion. The changes are those of a simple inflammatory process with moderate vascular dilatation, interstitial edema, and perivascular infiltration of round cells, and fibroblasts in the papillary zone of the corium.

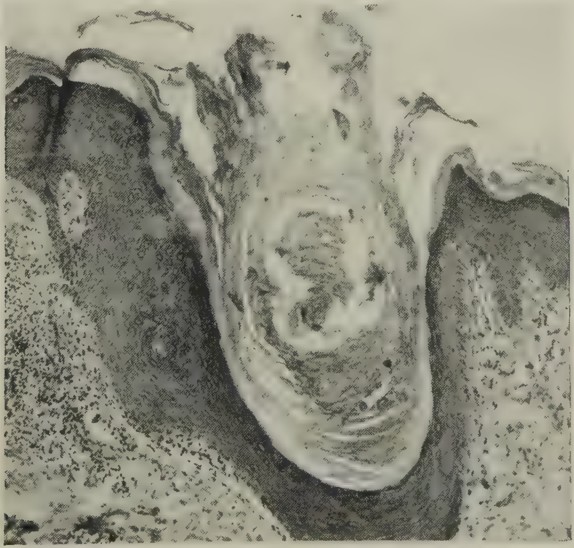

Fig. 10.—Pityriasis rubra pilaris, showing horny plug, hyperkeratosis of the epidermis, thickening of the granular layer and slight infiltration of lymphoid cells about the follicle.

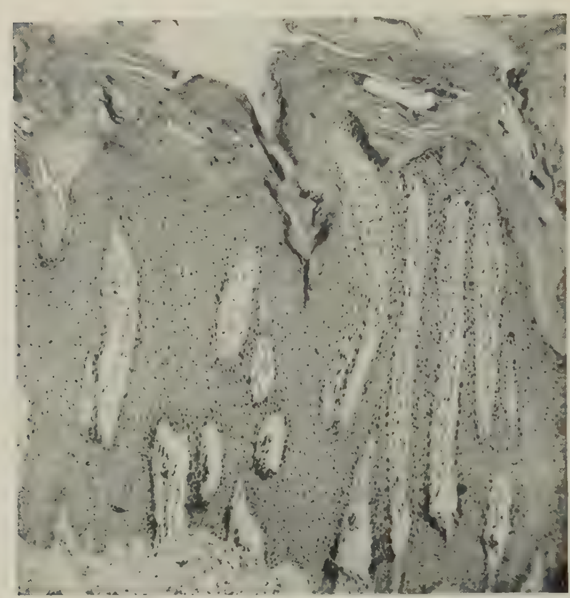

Fig. 11.—Psoriasis, showing acanthosis, enormous elongation and edema of the papillae, loss of the granular layer with hyper- and para-keratosis. (Courtesy of Dr. Frederick W. Birkman.)

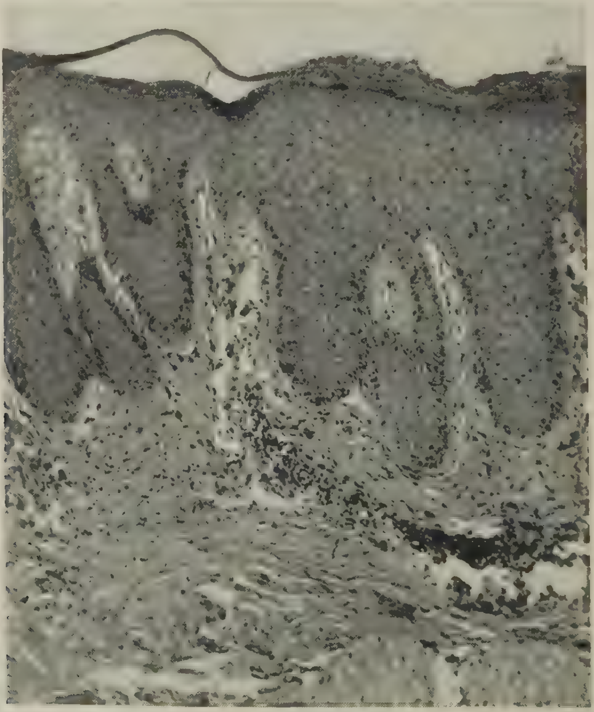

Fig. 12.—Dermatitis exfoliativa.

The papillae are elongated and frequently club shaped, and they reach far into the epidermis so that their apices are near the surface, consequently bleeding points are observed clinically when the scales are removed. In the epidermis an extensive proliferation occurs, associated with moderate interstitial and parenchymatous edema. The interpapillary processes become greatly elongated. In the dilated lymphatic spaces between the prickle cells occasional disintegrated leukocytes are found, but there are no vesicles. The edema, however, is sufficient to produce marked parakeratosis irregularly, so that spaces containing air occur between the scales, causing what is recognized clinically as micaceous scales. Minute intra-epidermal accumulations of polymorphonuclear leukocytes and cellular débris known as Monro's abscesses are present in the upper part of the epidermis.

Dermatitis Exfoliativa.—This process is more intense than psoriasis and shows dilatation of the subpapillary vessels and a profuse perivascular infiltration of both lymphocytes and polymorphonuclears, an interstitial and parenchymatous edema of the upper part of the corium and epidermis, and an extensive parakeratosis and scaling. In long-standing cases there may be some atrophy.

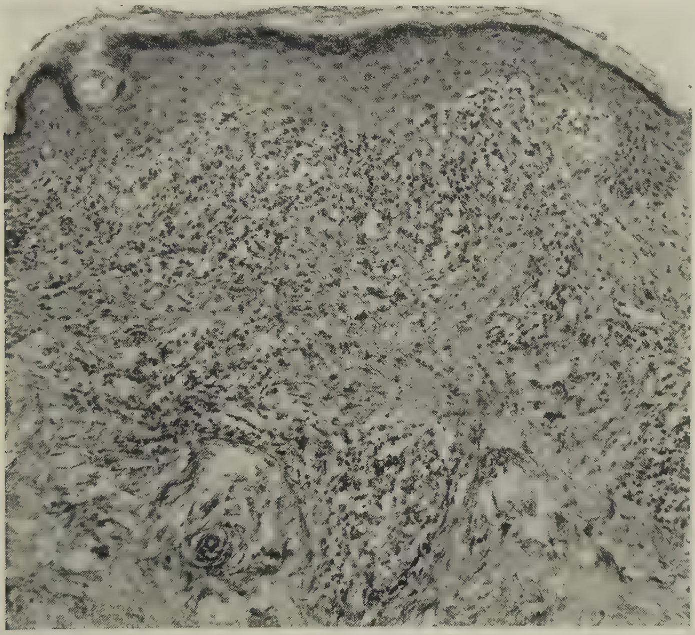

Fig. 13.—Lichen planus. Section, of papule showing thickening of epidermis, especially of granular layer, and fairly characteristic cellular infiltration in the corium. (Courtesy of Dr. Else A. Barthel.)

Parapsoriasis.—This disease is set apart by the remarkable sparsity of changes microscopically. The histological picture resembles that of normal skin except for slight vascular dilatation, edema, and an infiltration of lymphocytes in the upper corium. In the epidermis there are slight edema, moderate acanthosis, and parakeratosis.

Lichen Planus.—The histology in lichen planus is pathognomonic. Although changes in the corium predominate in acute cases, in the chronic hypertrophic type of the disease the principal alterations are in the epidermis. A characteristic feature is the limitation of the cellular infiltration to a regular band in the upper cutis. There is a sparsity of cells immediately subjacent to the basal-cell layer, and further below a dense infiltration is present which ends abruptly in the lower subpapillary zone. This feature is also seen in the early stages of the lymphoblastomas. It has diagnostic value and is best observed with a very low power objective. Further study of the section will show that the infiltration consists of a large number of lymphocytes and round fixed connective tissue cells or occasional plasma cells separated by bundles of collagen. The cells of the infiltration are arranged about the blood vessels, which are moderately dilated. If the section of a lichen planus papule is accurately cut through, the epidermal changes are seen to be distinctive. There are a follicular hyperkeratosis, a perifollicular acanthosis, parakeratosis, and granulosis leading to the formation of an umbilicated papule and to the production of scales. At the orifices of the sweat and sebaceous glands, the hyperkeratosis gives rise to horny plugs. In the late stages of the disease a considerable increase in chromatophores takes place.

Lichen Nitidus.—The lesion in lichen nitidus has a distinctive histological structure. It is located in the uppermost portion of the papillary body, immediately beneath the epidermis, which is thinned above it and occasionally invaded by it. The lesion is a sharply circumscribed granuloma, made up of small round cells, epithelioid cells, and sometimes giant cells, which are less closely packed near the center than at the periphery. As the granuloma tends to spread upward into the epidermis, the cells of the rete grow downward on either side of the nodule. The cells in the granuloma appear degenerated, but there is no caseation. When more than one papule is in the specimen, as in a confluent patch, there may be several in different stages of evolution, the early nodules being less characteristic. The walls of the blood vessels supplying the site of the lesion are thickened and about them are a moderate number of lymphocytes.

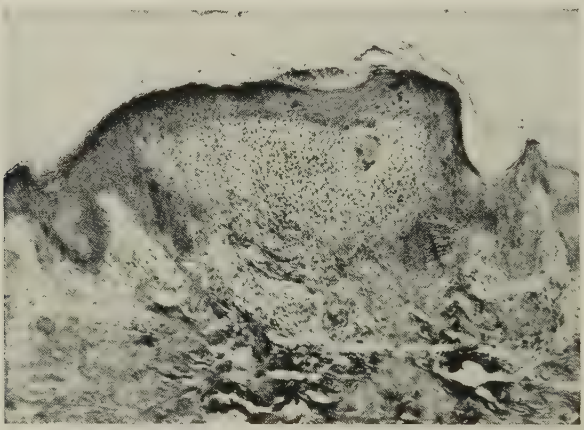

Fig. 14.—Lichen nitidus, showing papilla distended with tubercle-like infiltration. (Courtesy of Dr. J. Gardner Hopkins.)

Diseases Due to Cocci.—These vary pathologically according to the part of the skin involved and the depth and severity of the infection.

1. *Acne Vulgaris.*—This affection is characterized by a perifollicular inflammation, by comedones, and in pustular lesions by abscesses surrounded by a dense inflammatory exudate of polymorphonuclear leukocytes. Usually

staphylococci may be demonstrated, although they are sometimes absent in lesions of long standing. Indolent lesions frequently show, in addition to these findings, plasma cells, foreign body giant cells (chorioplaques), and proliferation of fixed connective tissue cells (fibroblasts).

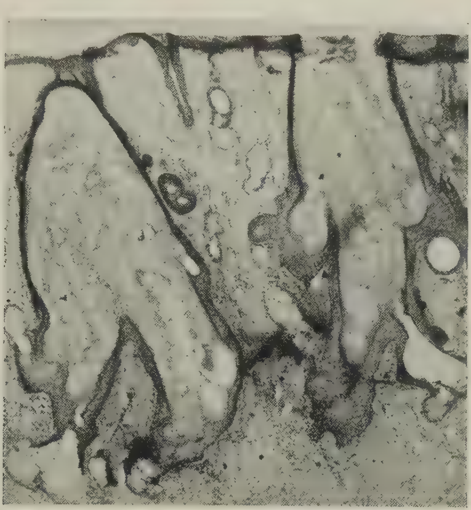

Fig. 15.—Acne vulgaris. Comedones. Low power.

2. *Impetigo.*—The histopathology in this disease is that of an extremely superficial inflammation about the funnel-shaped upper portion of the pilosebaceous follicle. A bulla or abscess is formed, usually within the epidermis, due to the action of staphylococci or streptococci, and groups of these organisms, together with débris of polymorphonuclear leukocytes and epidermal cells are found within it. In the corium there is a mild inflammatory reaction—vascular dilatation, edema, and infiltration of polymorphonuclears.

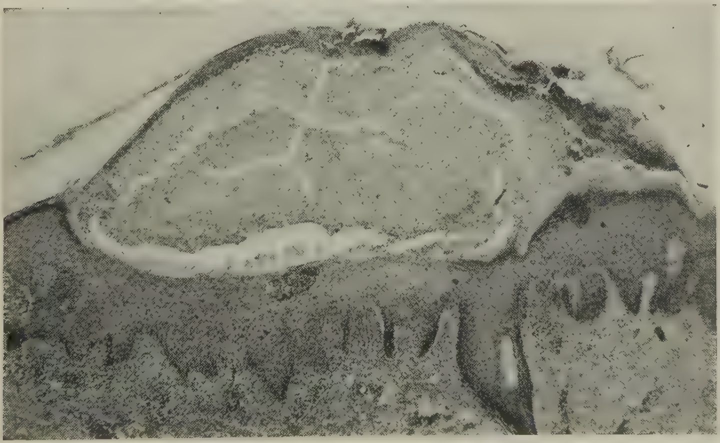

Fig. 16.—Impetigo contagiosa. Section of bulla.

3. *Ecthyma.*—This dermatosis presents the picture of deep inflammation due to pyogenic cocci, associated with a pronounced polymorphonuclear

infiltration, and the formation of abscesses, which begin about the pilosebaceous follicles.

4. *Erysipelas.*—The pronounced features of this disease microscopially are an intense edema, vascular dilatation, and a moderate collection of polymorphonuclear cells, lymphocytes, and streptococci in the enlarged lymphatic spaces about the vessels. The endothelial cells lining the lymphatic vessels are swollen. Abscess formation is common, and at times the edema is so intense that subepidermal collections of fluid form bullae. The epidermis is secondarily affected, showing edema and occasionally bullae.

5. *Furunculosis.*—The pathology is distinctive and consists of a deep abscess formed by staphylococci and polymorphonuclear leukocytes, generally beginning near a hair follicle, but occasionally associated with the sweat or ceruminous glands. The infiltration also contains lymphocytes, and in long-standing lesions, plasma cells, and foreign body giant cells. The cells are densely packed, and, as a rule, the central part of the lesion breaks down.

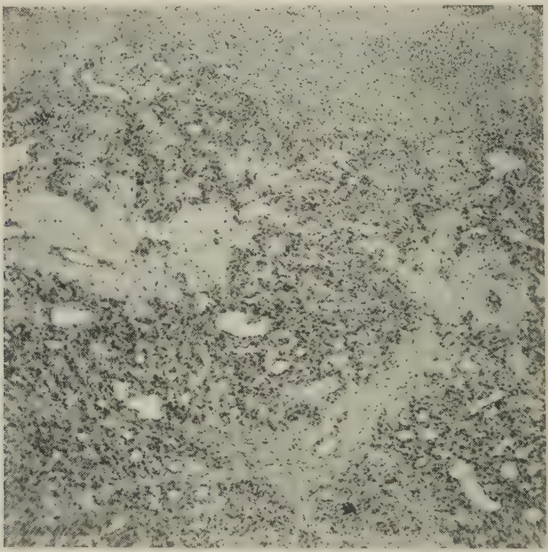

Fig. 17.—Granuloma pyogenicum. Section from center of lesion, showing newly formed blood vessels and connective tissue. Low magnification.

6. *Carbunculosis.*—The distinctive pathology of this disease is a deep pyogenic inflammation with multiple openings upon the surface. These openings are usually follicular. The deep inflammation is a diffuse, dense polymorphonuclear reaction, with the formation of multiple abscesses separated by connective tissue trabeculae or joined to one another deep beneath the surface of the skin, the pus from them burrowing to the surface along the walls of the follicles.

7. *Granuloma Pyogenicum.*—The growth is composed of newly formed blood vessels, which may be very numerous and large, and young connective tissue cells, together with leukocytes, plasma and mast cells. The histopathology of *dermatitis vegetans* is similar.

Actinomycosis and Blastomycosis.—In actinomycosis and blastomycosis the histopathology is that of an infective granuloma forming a deep nodular process with granulation tissue, epithelioid cells, plasma and giant cells, and degenerative changes. The ray fungus and its filaments may be found in actinomycosis, and the blastomycetes singly or in pairs and groups, occur in the corium in blastomycosis. In both diseases there are often sinuses and abscesses—which are small in blastomycosis, and large and deep in actinomycosis—containing polymorphonuclear leukocytes, miscellaneous débris, and the causative fungi.

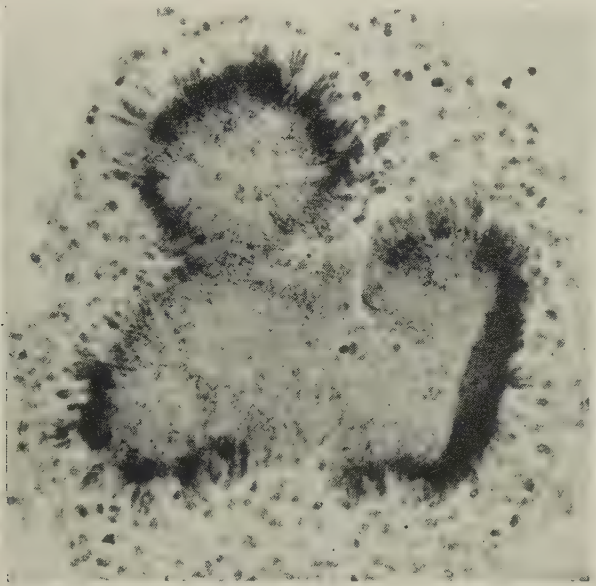

Fig. 18.—Ray fungus of actinomycosis. "Sulphur granule" from pus, showing filaments in center and clubs at periphery. High power. (Courtesy of Dr. C. W. Emmons.)

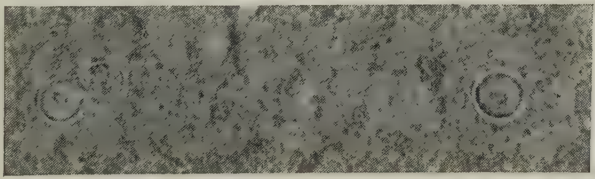

Fig. 19.—Blastomycetes in pus. (Courtesy of Dr. James H. Mitchell.)

Tuberculosis Cutis.—The microscopical pathology of cutaneous tuberculosis differs from the lesions observed elsewhere in that the tubercles rarely undergo caseation, fibrosis, and calcification. The tubercle in the skin also does not show the orderly arrangement of its cellular elements found in that of other organs. It is composed chiefly of epithelioid cells, although giant cells and lymphocytes are usually present. The epithelioid cell is named from its resemblance to the cells of the epithelium. It is an irregularly shaped, broad cell with a homogeneous cytoplasm and a large oval nucleus containing chromatin granules. The giant cells always suggest tuberculosis. They are usually of the Langerhans type, with many nuclei arranged in a ring at the periphery of the well-developed cytoplasm. Whether they are formed from syncytium of epithelioid cells is undecided, as is also their phagocytic power. The epithelioid and giant cells are usually surrounded by lymphocytes, and at the edge of the lymphocytic infiltration there may be found plasma cells which have a tendency to be arranged along the blood vessels, the tubercle itself usually being avascular. The tubercles are frequently multiple and conglomerate.

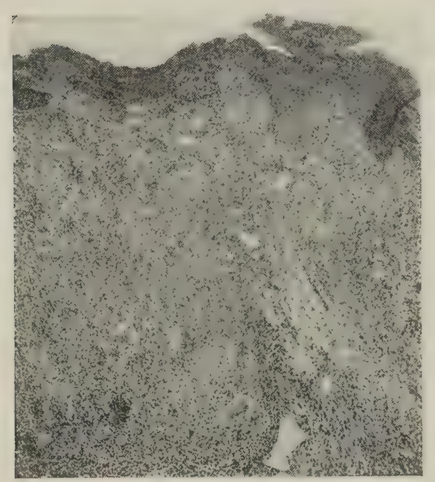

Fig. 20.—Lupus vulgaris, showing granulomatous infiltration with tubercle containing giant cell below superficial ulceration.

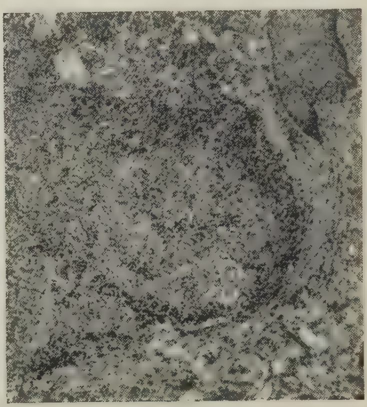

Fig. 21.—Epithelioid tubercle in lupus vulgaris. Low power.

In **lupus vulgaris** the changes are chiefly in the corium, where there is cellular infiltration of the granulomatous type with the formation of tubercles, at the center of which tubercle bacilli may occasionally be observed. The epidermis is secondarily affected, sometimes being flattened, and at other

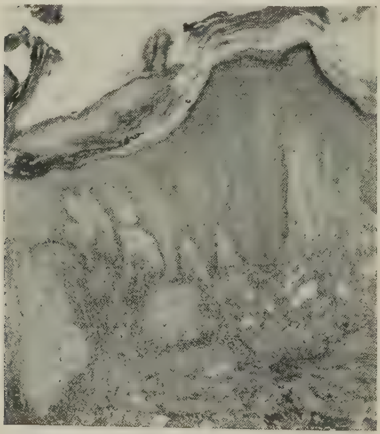

Fig. 22.—Tuberculosis verrucosa cutis, showing tubercles at the base of the hypertrophied epidermis.

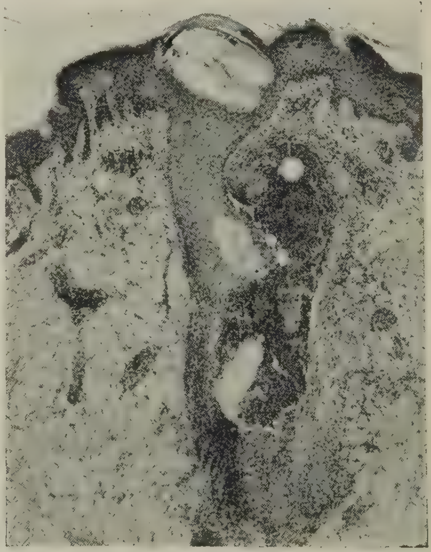

Fig. 23.—Papulonecrotic tuberculide, showing dense lymphocytic infiltration along the hair follicle, which has been partially destroyed by the inflammatory process. As usual, there are no tubercles.

times being hypertrophic. In the tumid type of lupus vulgaris the elementary tubercle may be more or less obscured by intense edema.

In **tuberculosis verrucosa cutis,** in addition to the usual tubercle, there are a considerable overgrowth of granulation tissue and the formation of new blood vessels with a predominating acanthosis and hyperkeratosis. Secondary infection with pyogenic cocci may lead to miliary abscesses, ulcerations, or verrucous thickenings.

In **scrofuloderma** the focal arrangement in tubercles is less distinct, the infiltration being diffuse and dense in the deep cutis. In erythema induratum and other types of scrofulous gummas, tubercles develop about one of the deep lymphatic vessels or veins, forming a granulomatous nodule, which ultimately breaks down and ulcerates.

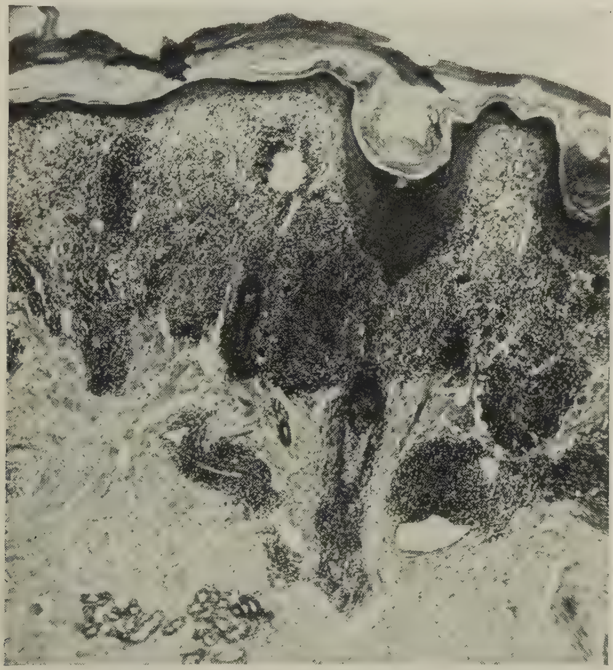

Fig. 24.—Lupus erythematosus. Note hypertrophy of epidermis, follicular horny plugs, edema, and degeneration of collagen in the papillary layer and dense polymorphous infiltration extending down along hair follicles and about blood vessels. Low power. (Courtesy of Dr. Frederick W. Birkman.)

The character of the infiltration in the **papulonecrotic tuberculide,** in lichen scrofulosorum and lichen nitidus shows considerable variation in different cases, depending upon the stage of evolution of the particular lesion selected for examination. Generally the cellular infiltration is composed of lymphocytes, or these and epithelioid cells, although occasionally giant and plasma cells are present.

Lupus Erythematosus.—The pathologic histology is usually sufficiently characteristic to warrant an accurate diagnosis. The blood vessels are dilated, and a dense perivascular infiltration of round cells occurs in the upper part of the corium, together with granular and basophilic degeneration of the cells and connective tissue fibers, and a profound dilatation of the lymphatic vessels. Plasma cells may be present. The epidermic changes in the early stages are edema, acanthosis, and the formation of horny plugs at the openings of the follicles and sweat ducts, and later there is slight atrophy. In lupus erythematosus, granulomatous nodules and giant cells are not found.

Leprosy.—The histological structure of the leprous nodule is that of a granuloma. In the early phases, it consists of an indeterminate cellular accumulation of lymphocytes, connective tissue cells, and of mast cells. Later plasma cells and characteristic lepra cells may be found. The latter are large vacuolated cells with one or more nuclei and not infrequently contain bacilli. The micro-organisms are also found in large numbers about the vessels and nerves of the affected area. The epidermis may be thinned from pressure, or missing as the result of ulceration.

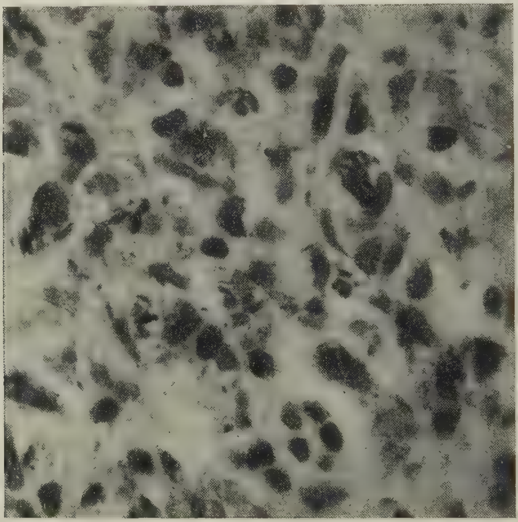

Fig. 25.—Lepra nodule. Ziehl-Neelsen stain. Note acid-fast bacilli in sheaves in the lepra cells and also scattered through the tissue.

In the maculo-anesthetic type of leprosy the lesions are in the peripheral nerves, and the atrophic changes in the skin are secondary to such involvement, being of a nonspecific character.

Syphilis.—The chancre is the prototype of other syphilitic lesions and is characterized by a dense infiltration of round cells and plasma cells, by a proliferation of fibrous tissue, which accounts for the induration, and by an arteritis of the deep cutaneous vessels, which begins with the proliferation of the endothelial cells of the intima and progresses until all coats are involved and the vessel is obliterated. The infiltration is at first limited to the proximity of the vessels, forming collarettes about them. Later it becomes diffuse, filling the entire field in a uniform manner, except at the edges of the lesion where it is chiefly perivascular. Giant cells may be present, and due to ulceration, there may be many polymorphonuclear leukocytes.

The roseola and other skin eruptions of the secondary stage show essentially various degrees of the above changes, with some tendency to necrosis and superficial ulceration, but generally healing and fading away. The reaction begins in the perivascular lymph spaces, which become filled with lymphocytes and plasma cells, although the pustular types show many polymorphonuclears. The vessels are dilated and there is a panarteritis. The changes in the macular eruption are slight, and may suggest urticaria, but in the later secondary eruptions are pronounced, especially about the hair follicles, and may even simulate lichen planus or a granuloma.

Gummatous tertiary skin lesions show characteristic changes. A nodule composed of plasma cells, lymphocytes, epithelioid cells, and fibroblasts extends from the epidermis deep into the subcutis. Giant cells are rarely seen. Definite arrangement of the cells is usually lacking, contrary to the architecture of the miliary tubercle.

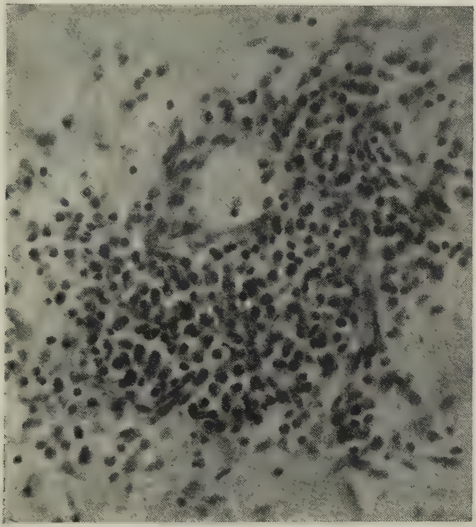

Fig. 26.—Arteriole of the base of a chancre, showing perivascular infiltration with plasma cells. High power. (Courtesy of Dr. J. Gardner Hopkins.)

Within the gumma the blood vessels are affected in various degrees by obliterative endarteritis. The three coats of the vessel walls are thickened and the lumen is reduced. Frequently there is a marked fibrosis at the periphery of the infiltration. Usually the cellular elements gradually degenerate and soften. The epidermis may be thinned by pressure, or eroded, with the formation of an ulcer. Tertiary syphilis may produce, in addition to the gumma, a diffuse infiltration of the tissues with plasma cells and fibroblasts, forming syphilitic granulation tissue.

Pemphigus.—In the upper layer of the corium there is an intense vascular dilatation, together with edema and a moderate infiltration of leukocytes and plasma cells around the vessels. Eosinophils may be numerous. In the epidermis the edema is both intra- and inter-cellular. The bullae form in the epidermis or occasionally beneath it and contain débris of epithelial cells and polymorphonuclear leukocytes, especially eosinophils, and fibrin.

Dermatitis Herpetiformis.—The changes in the corium consist of decided dilatation of the vessels, edema, and a cellular infiltration of lymphocytes and polymorphonuclears, especially eosinophils. The lymphatic spaces are widened. Alterations in the epidermis seem to be secondary to those in the corium. In the papular type there are only a few epidermal changes, consisting of moderate edema and acanthosis; but in the vesicular type the edema is pronounced, with the formation of vesicles in the deeper layers or beneath the epidermis. These contain cellular débris, eosinophils, and fibrin.

Mycosis Fungoides.—The pathologic picture varies according to the stage of the disease, but is always characterized by a polymorphic cellular infiltration, which except in the tumor stage is demarcated from the deeper part of the corium by its regular and sharp limitation to the upper part. The cells lie in the lymphatic spaces between the connective tissue bundles and about the vessels and skin appendages. They are principally of the connective tissue type, varying greatly in size, shape, and staining qualities. Some of the cells are large and oval, with a granular cytoplasm and one or more large nuclei, which not infrequently show mitotic figures. Smaller round cells, mast and plasma cells, and epithelioid cells are frequently encountered, and imperfect giant cells containing six to ten nuclei are sometimes seen. In the tumor stage the structure may resemble sarcoma or an infectious granuloma. Many of the constituent cells show fragmentation and granular degeneration. The changes in the epidermis are secondary, consisting of acanthosis, intercellular edema, and parakeratosis in the prefungoid stage, and thinning or erosion due to pressure when the tumors have developed.

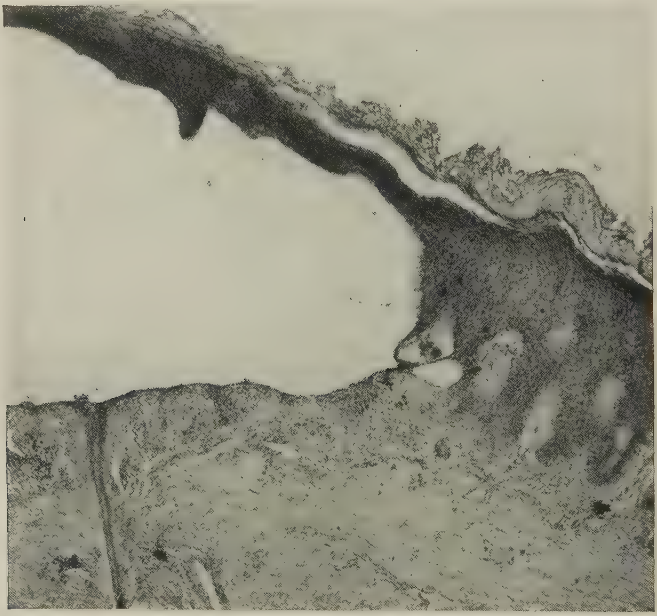

Fig. 27.—Pemphigus. Edge of bulla.

Fraser and others have stressed the relationship between mycosis fungoides, lymphatic leukemia, Hodgkin's disease, and lymphosarcoma.

Leukemia Cutis.—Histologically the circumscribed lesions in leukemia cutis are formed by a single spheroid of cells, or of multiple small focal dense accumulations of lymphocytes occurring either diffusely in the upper corium or as nodules and tumors in the corium or subcutis. The uniformity of the cells is characteristic. The infiltration begins about the blood vessels and spreads outward in all directions, surrounding the normal structures without destroying them. In all stages at the edges of the infiltration it is possible to demonstrate its tendency to adhere closely to the vessels, about which it frequently forms a cylindrical structure. At times plasma cells and fibroblasts are present. In lymphatic leukemia the cells are solely lymphocytes differing only in size, in the shape of the nucleus, and in protoplasmic content. Large and small lymphocytes and occasional lymphoblasts may be seen.

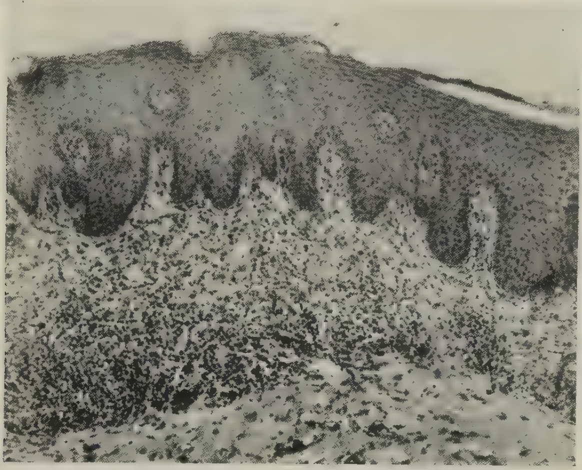

Fig. 28.—Mycosis fungoides. Stage of infiltration, showing dense polymorphous infiltration in the upper cutis, edema of the papillary layer, acanthosis and parakeratosis in the epidermis.

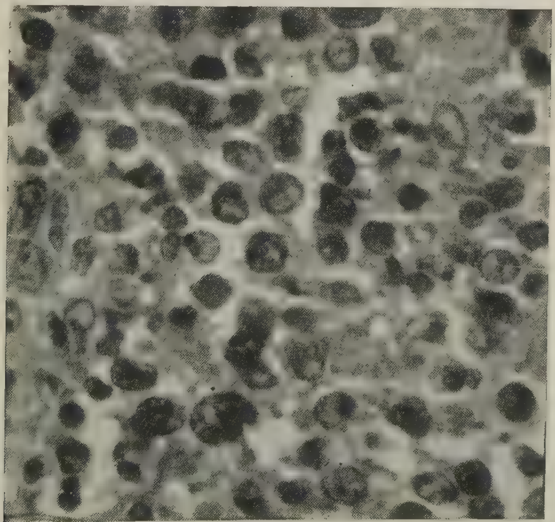

Fig. 29.—Mycosis fungoides. Section of tumor showing polymorphous character of cells. High power.

In myelogenous leukemia the cells are large mononuclears with neutrophilic, granular cytoplasm, being myelocytes or myeloblasts; and with them are multinucleated cells, eosinophils, and mast cells, which give a positive oxydase

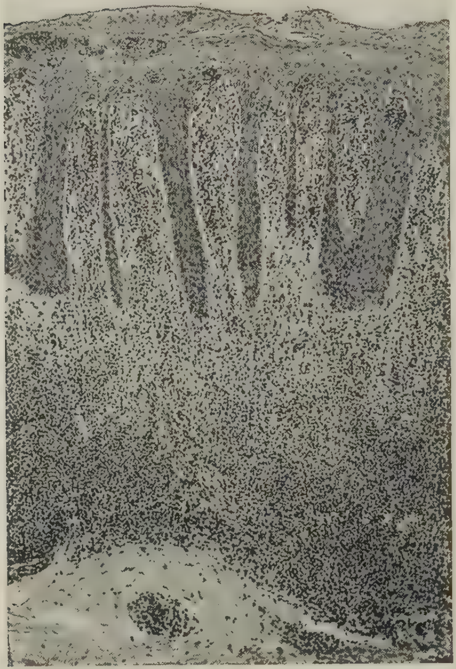

Fig. 30.—Universal lymphoid leukemia cutis showing dense homogeneous bands of infiltration with lymphocytes in the upper cutis, perivascular infiltration below and acanthosis and edema of the epidermis. (Courtesy of Dr. Lloyd W. Ketron.)

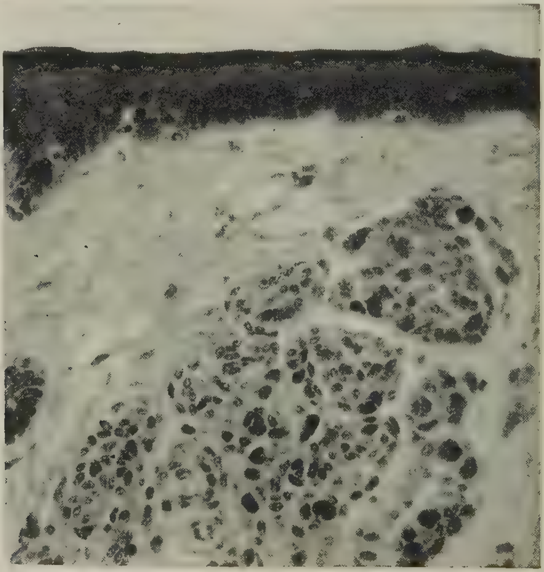

Fig. 31.—Pigmented nevus showing nest of clear cuboidal cells and melanoblasts in the upper cutis. Moderate magnification.

reaction. These cells infiltrate within a fine network of connective tissue which acts as a supportive stroma. In the diffuse variety of infiltration with erythrodermia, there is a dense, uniform or nodular, infiltrating band of the characteristic cells in the subpapillary zone and midcutis, which is separated almost completely from the basal-cell layer by a narrow band of normal connective tissue. The cells of the infiltration follow the vascular channels exactly, but do not encroach into the papillary bodies.

Nevi.—In vascular nevi there is a proliferation of new vessels, the exact manner being undetermined.

The nonvascular nevi may be divided into those which contain nevus cells and those which do not. The former group presents an elementary collection of nevus cells in the upper corium. According to the degree of development and the duration of the mole, compact collections of these cells extend deep into the corium. The cells are large and oval, and have large vesicular nuclei. Their origin is not determined; but Masson has demonstrated that at least some of them are derived from nerve end-organs. In other nonvascular nevi the histopathology varies according to the structures which compose the nevus. The verrucous nevi have a histology similar to that of the ordinary wart and occasionally there are cystic changes related to the sweat glands and ducts. In adenoma sebaceum there are an increase in number and a hypertrophy of the sebaceous glands, and a telangiectasia.

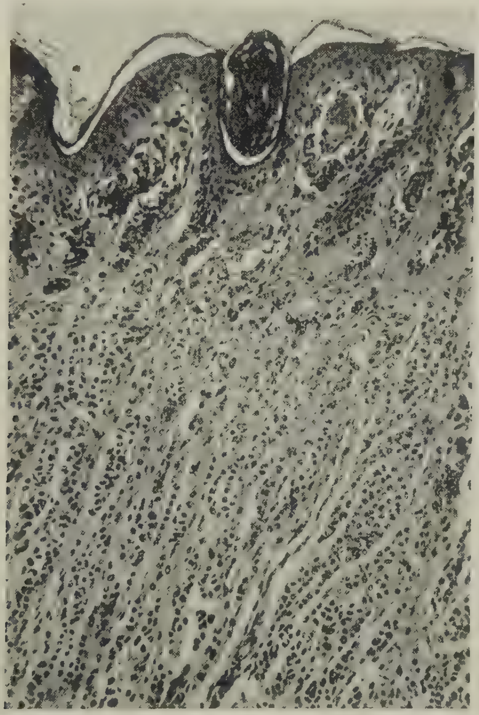

Fig. 32.—Papillomatous nevus showing group of nevus cells in the papillae and cords of cells extending deep into the cutis. (Courtesy of Dr. J. Gardner Hopkins.)

Warts.—In common warts the epidermis shows the principal histologic features. There is a prominent circumscribed acanthosis with elongated interpapillary projections and an overlying thickening of the corneous layer due to hyperkeratosis and parakeratosis. Mitoses may be present near the basal cell layer. In flat warts the main change is in the rete, while the stratum corneum is relatively unaffected. In the acuminate and seborrheic warts the alteration is principally an acanthosis with small increase of the corneous layer. In the corium beneath verrucae there is slight cellular infiltration.

Histologically **corns** are composed of concentrical corneous lamellae arranged about a conical core formed by compressed horny masses. In the corium the papillae are flattened by pressure, and there is some cellular infiltration.

Callosities show chiefly a hyperkeratosis and a thickening of the granular layer. The papillae beneath the lesion are flattened from pressure, and the corium may also develop mild inflammatory changes as a result of irritation.

Molluscum contagiosum has a characteristic histopathologic structure which varies somewhat according to the stage of development of the lesion. It is essentially an acanthoma, which in its growth downward compresses the connective tissue of the corium so that it forms a capsule. The tumor also becomes elevated due to an increase in its mass, and there is formed a central core which opens upon the surface and contains certain dyskeratotic cells called "molluscum bodies." The substance of the growth is broken up into lobules by trabeculae of connective tissue. In the lobules the different layers of the epidermis can be identified but degenerative changes are present in most of the cells except those of the basal-cell layer. The molluscum bodies are generally oval, with a capsule and the vestige of an eccentric nucleus.

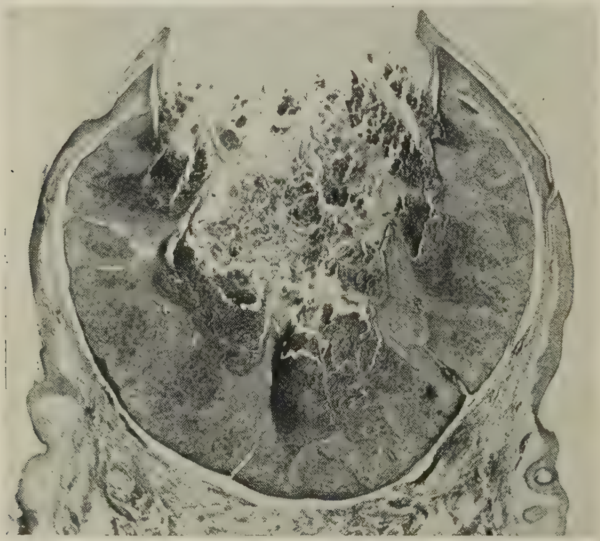

Fig. 33.—Molluscum contagiosum. (Courtesy of Dr. Frederick W. Birkman.)

Darier's disease is essentially a dyskeratosis, although there is an increase in all the layers of the epidermis, and particularly a hyperkeratosis about the pilosebaceous follicles. Generally the interpapillary prolongations are elongated and widened, but sometimes they are flattened by the pressure of overlying accumulations of horny material. The follicular orifices are filled with imperfectly formed and degenerated cells from the stratum corneum, and

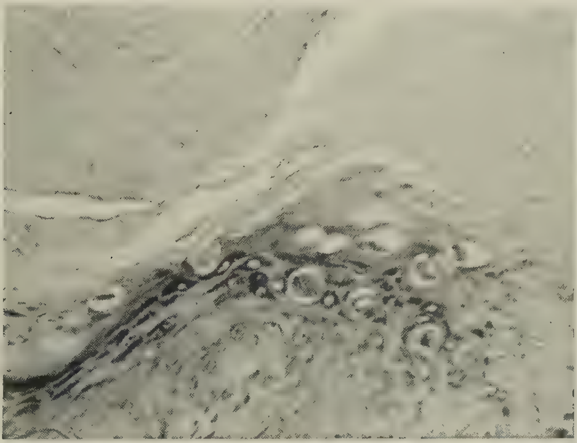

Fig. 34.—Darier's disease. Edge of a follicular plug showing *corps ronds* in the thickened granular layer and *grains* in the dense keratin layer above it. (Courtesy of Dr. J. Gardner Hopkins.)

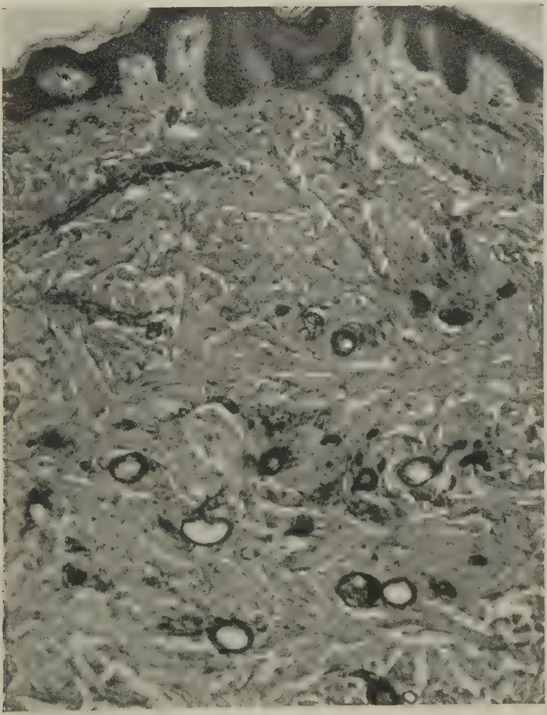

Fig. 35.—Syringocystoma. At extreme right and lower part of the field is a typical tailed cyst. Low power.

deeper in the rete there occur numerous mitoses and round degenerated cells with homogeneous or granular cytoplasm and nuclear fragments known as "corps ronds." These structures, which superficially resemble coccidia, led

Darier to attribute the disease to these parasites. An increased amount of pigment is present in the basal cells. In the corium pigment is also found, and there is a moderate cellular infiltration.

Acanthosis nigricans shows a marked acanthosis and an elongation of the interpapillary projections together with an increase of pigment in the cells of the basal layer and in the upper part of the corium.

In **syringocystoma,** in the upper cutis there are found irregularly oval cysts lined with epithelial cells and tubular structures, empty or containing cellular débris, which presumably consists of dilated sweat ducts developed from misplaced embryonal cells.

In **hydrocystoma** there is a dilatation of the occluded sweat duct by fluid containing degenerated epithelial cells. When the cystic collection is large the overlying epidermis is thinned by pressure and there are leukocytes about the neighboring vessels.

The histopathology of **benign cystic epithelioma** is described by Fordyce and others as consisting of strands and masses of embryonal cells similar to those of the basal layer or those of the external root sheath of the hair follicle. These strands in proliferating downward form cell nests similar to those encountered in malignant prickle-cell epithelioma. The cell nests contain granular, horny, or colloid material. Adenoid structures may be present.

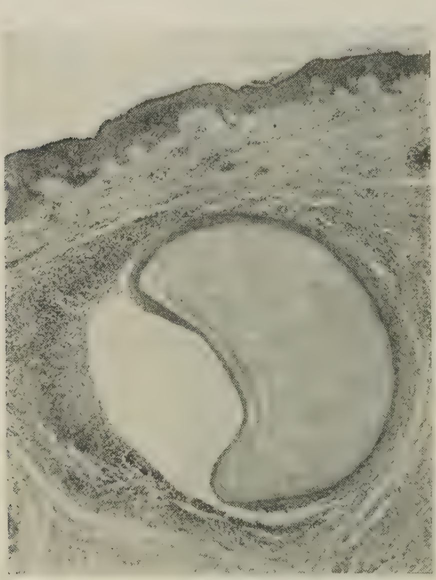

Fig. 36.—Benign cystic epithelioma. (Courtesy of Dr. Frederick W. Birkman.)

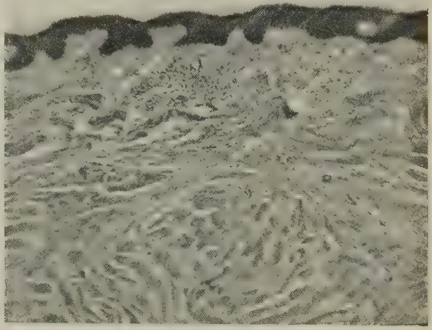

Fig. 37.—Keloid. Low power.

A **fibroma** is a benign connective tissue neoplasm composed of more or less compact spindle-shaped and round cells with deeply staining nuclei and coarse intercellular fibers.

In the **neurofibroma** the paraplasmic fibers are generally finer than those in the ordinary fibroma, and the substance of the growth may have a gelatinous consistency, within which, by special stains, fragments of medullated and nonmedullated nerve fibers may be demonstrated.

A **keloid** is a dense connective tissue growth composed of fusiform cells and connective tissue fibers, which are more compact and prominent in older lesions. There is a paucity of elastic tissue. By pressure the tumor causes thinning of the epidermis and atrophy of adjacent appendages.

A **lipoma** is a lobulated, encapsulated tumor composed of groups of fat cells held together by strands of connective tissue.

Myomas are tumors made up of smooth muscle fibers with characteristic fusiform nuclei. The cells lie in all directions. By pressure upon the overlying connective tissue a sort of capsule may be formed between the growth and the epidermis.

In a **neuroma,** histologically there are bundles of medullated or nonmedullated nerve fibers traversing a connective tissue framework with occasional ganglionic cells, and sometimes with large numbers of them.

A capsule of fibrous tissue surrounds the **sebaceous cyst,** and within it there are cheesy contents composed of fat, cholesterin crystals, epithelial cells undergoing fatty degeneration and, at times, lanugo hairs.

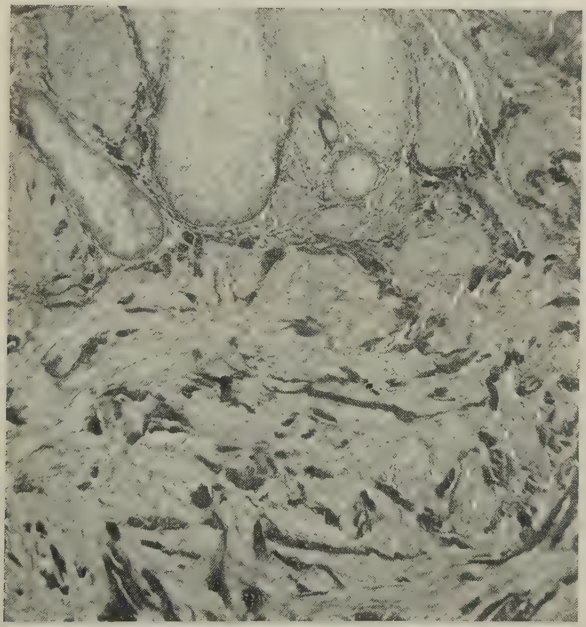

Fig. 38. Leiomyoma cutis. Van Giesen's stain. The bundles of smooth muscle are stained with picric acid and appear pale like the epithelium of the sebaceous gland. The remaining bundles of collagen are stained with fuchsin and appear dark. (Courtesy of Dr. Gerald M. Machacek.)

Regarding **pseudoxanthoma elasticum,** Macleod states: "Microscopical sections show that the nodule is due to the presence of a mass of swollen and fragmented elastic tissue fibers situated in the reticular part of the corium, which gives the staining reaction either of healthy elastin or of its degenerative product elacin. In several cases giant cells have been observed in which the nuclei were not arranged in a ring or horseshoe fashion, as in the giant cells of tuberculosis, but formed a cluster within a mass of faintly stained protoplasm."

In **colloid degeneration** of the skin the chief microscopic features are a colloid degeneration of the collagen and the elastic fibers of the corium showing as a focal mass of débris, the cells about and within which remain unaltered.

Xanthelasma, according to Pollitzer, is a peculiar cholesterol and fatty degeneration of cutaneous striated muscle fibers, usually of the m. platysma. In early lesions these fibers are still visible, but in the later stages there is scarcely any trace of them. Strands of fat cells and reticulated structures known as xanthoma cells lie adjacent to the muscle fibers. These have round deeply staining nuclei and are degenerated remnants of striated muscle fibers.

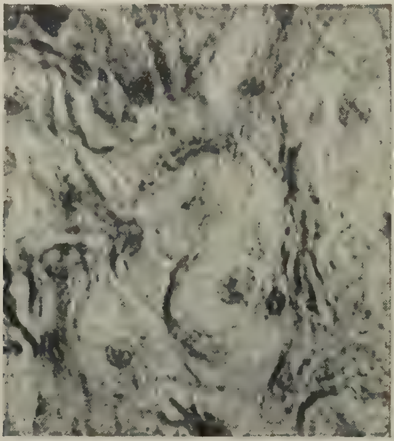

Fig. 39.—Xanthoma tuberosum multiplex. Note typical vacuolated cells. (Courtesy of Dr. Frederick W. Birkman.)

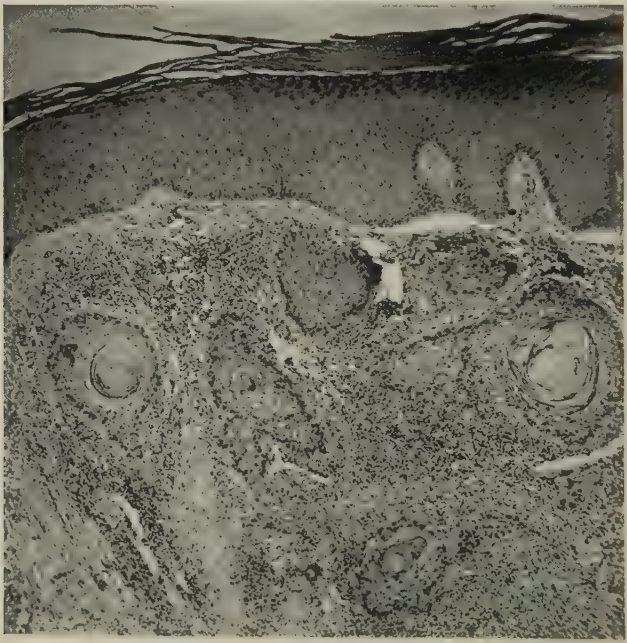

Fig. 40.—Squamous-cell epithelioma. Highly differentiated. Note pearls in center of the tumor nodules and intense inflammatory reaction about them.

In **xanthoma tuberosum multiplex** there occur a dilatation of the vessels and a perivascular infiltration of small round cells, fibroblasts, and large multinucleated cells called "xanthoma cells," which may also be scattered throughout the tissue or may be arranged in small groups. They may be so large and nucleated that they are called xanthoma giant cells. Profuse deposits of fat and crystals of cholesterin may be demonstrated in these cells or in the lymph spaces.

The histology of **xanthoma diabeticum** is similar to the above.

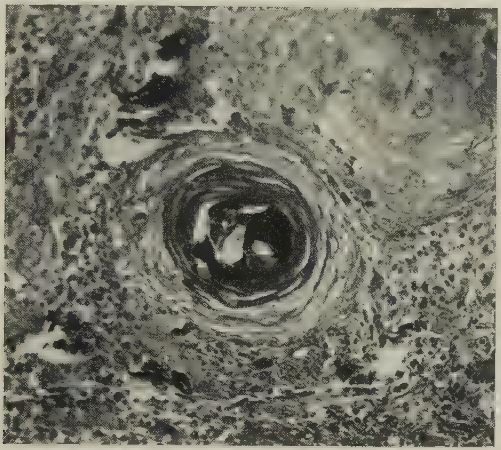

Fig. 41.—Epithelial pearl from squamous-cell epithelioma.

Malignant Neoplasms.—*Squamous-cell carcinoma* of the skin regularly has a characteristic composition, flat squamous epithelial cells, intercellular fibrils, and corneous pearls being present except in occasional rapidly growing tumors where young cells with hyperchromatic nuclei extend in finger-like projections or strands into the underlying structures in an uncontrolled man-

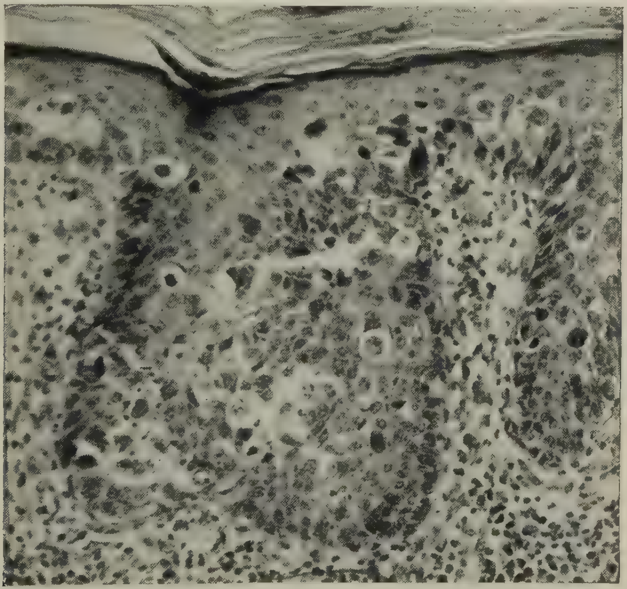

Fig. 42.—Paget's disease of nipple showing so-called Paget's cells in lower portion of epidermis. (Courtesy of Dr. Frederick W. Birkman.)

ner. Round cells, lymphocytes, and plasma cells usually appear about the growing edges, especially in the early stage. If there is infection, polymorphonuclear leukocytes appear in the infiltration. In the metastases the cancer cells may lose their adult character owing to destructive proliferation and assume the attributes of imperfectly formed spindle cells.

The beginnings of *Paget's disease* have been found in milk ducts beneath the nipple, although the connection of the disease with the milk ducts is not always demonstrable. As the lacteal ducts are modified sebaceous ducts, some observers have claimed a common source for both extramammary and mammary cases of the disease.

The rete is thickened, and there are edema, dyskeratosis, and a vacuolization of the cells. Large round clear staining cells with hyperchromatic nuclei are present and are called "Paget's cells." They appear singly or in small collections and are often undergoing mitosis. In the later stages of the disease these cells become more numerous. In the corium there is an infiltration of small round cells, lymphocytes, and plasma cells.

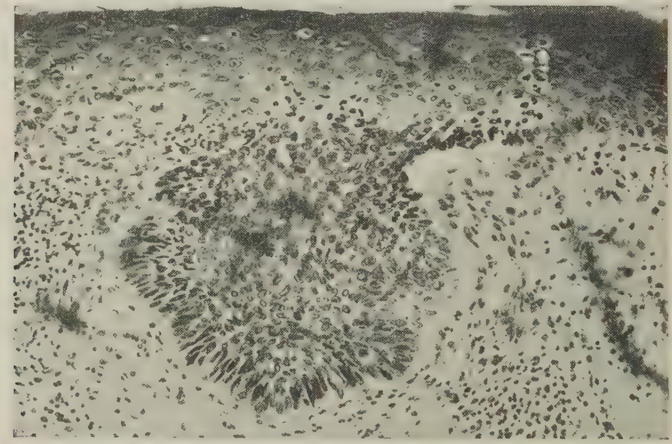

Fig. 43.—Small nodule of basal-cell epithelioma. (Courtesy of Dr. Fred Wise.)

In *basal-cell epithelioma* the early lesion shows accumulations of small polyhedral cells resembling those of the stratum germinativum, with swollen nuclei and small nucleoli. These occur within the epidermis as thickenings of the basal-cell layer or immediately beneath it as downgrowths connected with it. After the growth has progressed, regular compact columns of these cells fill the tissue spaces of the corium, and a connection with the epidermis may be difficult to demonstrate. Prickles, cornification, and pearl formation are not observed in pure basal-cell growths, instances of their presence belonging to the transitional-cell group.

Basal-cell carcinoma arising from the epidermal appendages may have an adenoid character due to an imperfect attempt to reproduce the glandular structures.

Transitional-cell carcinomas vary in histologic structure, but may be roughly divided into two types: (1) The mixed type characterized by features typical of both basal- and squamous-cell growth, in apposition; (2) the intermediary type in which the forms of the cells themselves are neither typically basal nor typically prickle cells.

Tumors arising from pigmented nevi—*melanoma*, also called *nevocarcinoma* —possess the features of the original nevus but, in addition, show cellular

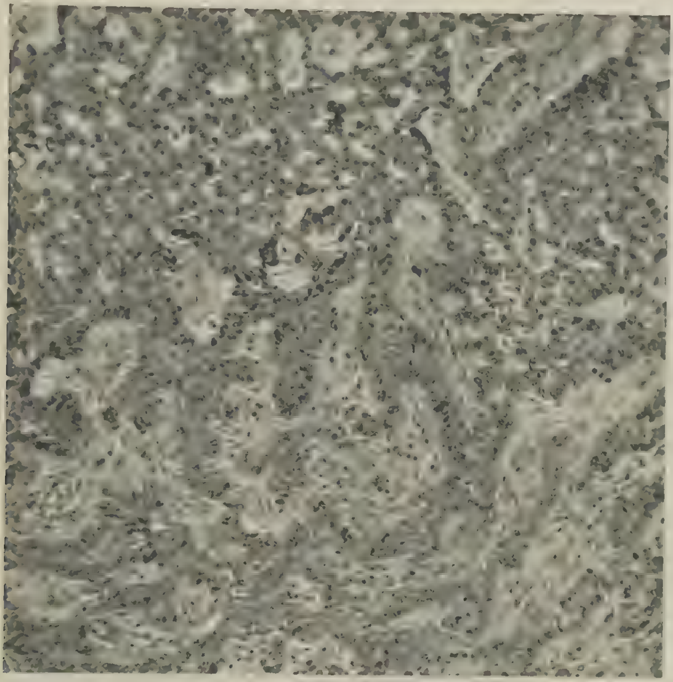

Fig. 44.—Basal-cell epithelioma.

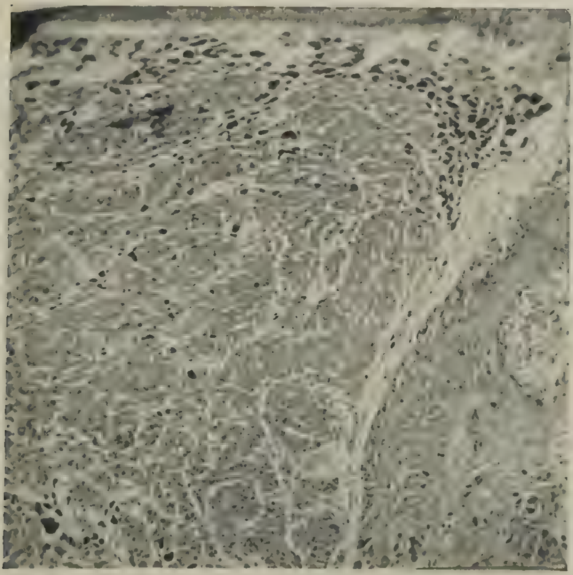

Fig. 45.—Melanoma showing pigment among tumor cells.

hypertropny, hyperchromatic nuclei, and some mitotic figures. Frequently an increase in pigment occurs, the amount varying considerably in different tumors and in parts of the same tumor. The amount of pigment seems to be no criterion of the degree of malignancy. The lesions are spread along the lymphatics or blood vessels. The metastatic growths show wide variations in the type of cells, some being large, rounded clear cells, others being small round granular cells.

The majority of the *sarcomas* primary in the skin are composed of small or large spindle cells. These may be densely packed, or separated by considerable stroma, and may be arranged in bundles, which form curved patterns. The growths are usually well supplied by blood vessels. According to Ewing, most of the spindle-cell sarcomas of the skin are of neurogenic origin. Certain ones seem to arise from the blood vessels.

The histopathology of *multiple hemorrhagic sarcoma* varies considerably according to the stage of the disease. Early lesions are of a granulomatous nature, with new and dilated lymph and blood vessels, edema, hemorrhages, blood pigment, and dense infiltrations of lymphocytes, plasma and mast cells. In the later phases there is a connective tissue proliferation, which may be very extensive.

In *metastatic carcinoma* and *sarcoma* in the skin there may be wide variations in structure from the original growth. In carcinoma, extensive anaplasia may occur, so that a well-differentiated primary growth may in secondary deposits appear undifferentiated. In the metastases of melanoma, there is a great diversity in the quantity and distribution of the pigment, and the cells may be highly anaplastic.

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CHAPTER III

SYMPTOMATOLOGY AND GENERAL DIAGNOSIS

SYMPTOMATOLOGY

The clinical pictures presented by the vast number of skin affections vary widely and yet in some instances possess identical features, thus creating some confusion and making diagnosis difficult. The same disease may show variations under different conditions and in different individuals. Symptoms, which are found diversely combined and associated with internal disturbances or a generalized infection, may be modified by treatment and obscured by accidental influences.

Constitutional symptoms as malaise, headache, chills, *et cetera*, may be present, but are of little significance in diagnosis in dermatology because of a lack of distinct characteristics. Subjective symptoms may be the only evidence of physical disorder, as in pruritus, or may be entirely absent. In most instances chief reliance is placed on objective symptoms of one or more lesions which can be seen and felt.

Subjective Symptoms.—These consist of itching, sensation of heat or cold, burning, tingling, prickling, stinging, biting, formication, and pain. Anesthesia and hyperesthesia, an absent or heightened sensibility, may also be experienced by the patient. Such symptoms are, however, of uncertain diagnostic nature, for the patient is likely to minimize or exaggerate or otherwise misinterpret his sensations according to the individual temperament and intelligence. It is often possible to corroborate sensory disturbances by neurological tests.

Itching, which is the most common of the subjective symptoms in skin affections, varies in degree and type. It may be a mere prickling or tingling, or its severity may be so intense as to be intolerable. The cause probably is excitation of peripheral nerve endings, or pressure, or the action of toxic substances, or it may be an irritant operating externally as in parasitic diseases. Itching may be spasmodic or continuous, and may occur in paroxysms. It is commonly associated with eczema, urticaria, dermatitis venenata, dermatitis herpetiformis, scabies, lichen planus, mycosis fungoides, and pediculosis; it is also encountered more or less in all inflammatory dermatoses, in xerosis, in metabolic disorders, and nervous states.

Pain is not of so common occurrence; it may be boring, as in herpes zoster, shooting, as in locomotor ataxia, or throbbing, as in boils and carbuncles.

Objective Symptoms.—According to the nature of the pathologic process the lesions assume more or less distinct characteristics. They may be uniform or diverse in size, shape, and color and may be in different stages of evolution or of involution. The original lesion is known as (1) the primary or elementary lesion. It may continue to full development, or as a result of regression or of trauma, or other extraneous factors may undergo modification, and in this altered form is known as (2) a secondary lesion. A type of lesion may sometimes be primary in one cutaneous affection, and secondary in another.

Primary or Elementary Lesions.—These are of the following forms—macules, papules, nodules, tubercles, tumors, wheals, vesicles, bullae, and pustules. Each will be considered separately.

Macules (Maculae, Spots).—Macules are variously sized circumscribed alterations in the color of the skin, without elevation or depression. They are usually rounded, but may be oval or irregular in shape, and may be distinct in outline or fade into the surrounding area. Depending on the cause, they differ in color, being bright red when due to arterial hyperemia, as in roseola and inflammation; purplish, yellowish, and greenish when due to extravasation of blood, as in purpura and bruises; brownish as in freckles and other pigmented changes (vitiligo and chloasma), white as in leukoderma, and a variety of colors as in tattoo marks or in deposits of chemicals, such as silver and iodine.

Macules may constitute the whole of the eruption or a part, or may be merely an early phase or an associated symptom. Occasionally the spots tend to become slightly raised, when they are designated *maculopapules.* They may be congenital or acquired, scanty or profuse, transient as in erythema, or more or less permanent as in vitiligo and freckles. They may or may not disappear on pressure.

Papules (Pimples or Papulae).—These are circumscribed, solid elevations with no visible fluid, varying in size from a pinhead to a pea. They may be acuminate, rounded, conical, flat, or umbilicated, and whitish (as in milium), red (as in eczema), yellowish (as in xanthoma), yellowish-brown (as in lupus vulgaris) or blackish (as in melanoma).

Papules may be seated in the corium, around sebaceous glands, at the orifices of the sweat ducts, or at the hair follicles. They may be of soft or firm consistence and the surface may be smooth, or rough, and capped by scales when they are known as squamous papules. When situated at the hair follicles the lesion may have a horny spine (as in keratosis pilaris).

Some papules are discrete and irregularly distributed as in papular urticaria, while others are in groups as in lichen scrofulosorum. Some persist as papules, whereas those of the inflammatory type may progress to vesicles and even to pustules, or may form ulcers before regression takes place. Papules may be associated with itching and burning as in eczema, or may be without subjective symptoms as in lupus vulgaris. Some completely disappear by absorption, while others leave a stain or a scar.

Nodules or *tubercles* are well considered as a form of papule, being larger solid lesions, but generally of a persistent character, perhaps midway between a papule and a small tumor. They differ from papules in being in close association with the corium or subcutaneous tissue, and in projecting notably both upward and downward.

Tumors.—These are soft or firm, freely movable, or fixed masses, walnut-to egg-sized and of various shapes. They may be elevated, or deep seated and, in some instances, are pedunculated (fibromas). Tumors have a tendency to be rounded, and their consistence depends upon the constituents of the lesion, which may be either inflammatory or neoplastic. Some tumors remain stationary indefinitely, while others increase in size, or break down as a result of suppuration and necrosis, and disappear.

Wheals (Urticae, Pomphi).—Wheals are evanescent, edematous, flat elevations of various sizes. They are usually oval, and whitish or pinkish, and are surrounded by a pink areola. They may be discrete, or coalesce to form solid plaques; and they may be round, irregular, or linear when due to scratching. These lesions develop rapidly in a few seconds, and disappear more slowly. Itching and tingling are almost always present.

A wheal has its seat in the upper part of the corium or papillary layer. At first there is a dilatation of the blood vessels producing a peripheral hyperemia, with a sudden exudation of serum into the perivascular spaces, followed by capillary contraction. When the affected vessels relax absorption takes place. Wheals may result from external irritants, as bites of insects, contact with certain plants, and from sunlight, or may be due to internal causes such as allergy, toxins, or drugs.

Vesicles (Small Blisters or Vesiculae).—Vesicles are circumscribed, epidermal elevations of pinhead to pea size, and contain a clear fluid. They may be pale, or yellowish from seropurulent matter, or reddish from serum mixed with blood, and occasionally have deep reddish areolae. The apex may be rounded, acuminate, umbilicated, or torn. Vesicles may be discrete, irregularly scattered or arranged in groups or rows. They may arise directly or from a macule or papule, and generally lose their identity in a short time, breaking spontaneously, or developing into blebs through coalescence or enlargement, or into pustules. When the contents are of a seropurulent character the lesions are known as vesicopustules.

The varying thickness and firmness of the upper corneal layers determine the course of the lesions. Vesicles may be intra-epidermal or subepidermal. Some are superficially situated, involving only the stratum corneum. When the latter is a delicate, newly formed horny layer, the walls are thin and tend to rupture spontaneously or from slight rubbing. Where the epidermis is thick and tough, the vesicles are deep beneath the granular layer extending into the papillary layer of the corium. The cells bordering on the wall of the vesicle show a moderate edema, and in their further course may lose their capacity to be stained and finally undergo dissolution. Simultaneously in the contents of the vesicle there appears a moderate number of leukocytes, which in a severe inflammation become embedded in fibrinous network. When the edema is of this intracellular nature, the lesions are known as parenchymatous vesicles.

Vesicles consist of either a single cavity (unilocular) or of several compartments (multilocular), containing fluid. When the collection of fluid is in the spaces between cells, the vesicles are known as interstitial. Subjective symptoms such as burning and itching may be present. In the healing process the vesicle is pushed upward, and whatever of the top has not been destroyed shows a moderate desquamation. A simultaneous proliferation of the prickle cells leads to the formation of epithelium, with the reappearance of a stratum granulosum and stratum corneum.

Bullae (Blebs, Blisters).—These are rounded or irregularly shaped elevations of the epidermis containing serous or seropurulent fluid. They differ from vesicles only in size, being larger than a pea. Bullae may be accompanied by itching and burning, and in the stage of full development by a feeling of tension. They may arise as blebs or from the enlargement or the coalescence of several vesicles, or they may develop from erythematous papules. They are usually single chambered and located superficially in the epidermis, so that their walls are thin and subject to rupture spontaneously or from some slight injury. After rupture, remnants of the thin walls may persist, and together with the exudate may dry to form a thin crust, or the broken bleb may leave a raw and moist base, which may be covered with seropurulent or purulent slough, and more rarely with irregular vegetations (as in pemphigus vegetans). When the blebs are deeply situated, ulceration and scarring often result (herpes zoster gangrenosus). Vesicles and bullae may be produced by allergic reactions, by chemical or vegetable local irritants, or by infection, nerve disturbance, the consumption of drugs, and by debility.

Pustules (Pustulae).—These are small elevations of the skin containing pus. They are similar to vesicles in shape, and may also have an inflammatory areola, and be unilocular or multilocular. They are usually whitish or yellowish, but may be reddish if they contain blood with the pus. They may originate as pustules, or may develop from papules or vesicles, passing through transitory early stages when they are known as papulo- or vesico-pustules. When superficial they may break spontaneously and form crusts, or may dry up without rupture, but if the corium is involved, evacuation may be slow. Pustules occur frequently around the pilosebaceous follicles, and are common in many dermatoses. The depth and degree of the inflammatory process determine the subjective symptoms, and whether there is scar formation depends upon the extent of the tissue destruction.

Secondary Lesions.—These are of manifold varieties, of which the most important are scales, excoriations, fissures, crusts, ulcers, and scars.

Scales (Exfoliating Epidermis, Epidermal Exfoliations, Squames, Squamae).—Scales are dry or greasy laminated masses of epidermis. The body ordinarily is undergoing a scarcely perceptible desquamation in the form of tiny thin epidermic particles. When the formation of epidermal cells is rapid or the process of normal cornification is interfered with, pathologic exfoliation occurs, producing scales. These vary in size, some being fine, delicate, and branny as in pityriasis versicolor, others being coarser as in eczema and ichthyosis, while still others are stratified as in psoriasis. Large sheets of desquamated epidermis are seen in exfoliative dermatitis and scarlet fever. Generally the exfoliations are thin, dry, brittle shiny flakes, but sometimes they are greasy and dull from the sebum and sweat. They vary in color from whitish, grayish to yellowish or brown from the admixture of dirt; and occasionally they have a silvery sheen from the permeation of the cells with air.

Scaling is common in a large number of inflammatory diseases of the skin, being associated with edema of the epidermis, and *parakeratosis*.

Excoriations (Abrasions, Erosions, Scratch-marks).—An excoriation is a superficial displacement of skin tissue, usually involving only the epidermis and rarely reaching the papillary layer of the corium. The erosions are caused by scratching with the fingernails in an effort to relieve itching in a variety of diseases (eczema, pruritus, scabies), by other mechanical traumatisms, and even from constant friction. Although of various sizes and shapes, depending upon the agent and its line of action, excoriations are generally small, linear lesions, bright red or dark in color, due to dried blood. Frequently there is an inflammatory areola about the excoriation or a covering of yellowish dried serum over it.

Excoriations may be accompanied by inoculation of pyogenic microorganisms and the formation of pustules, occasionally associated with enlargement of the neighboring lymphatic glands.

Fissures (Cracks, Rents, Clefts, Rhagades).—A fissure is a linear cleavage into the epidermis or the epidermis and the corium, caused by disease or injury. These lesions may be single or multiple, and vary from tiny cracks to clefts several millimeters in length, with sharply defined margins. They may be dry or moist, reddish, straight, curved, irregular, and branching. They occur most commonly when the skin is thickened and inelastic from inflammation, especially in regions subjected to frequent movement. Such areas are the flexures, the palms, the clefts between the fingers and toes, and at the angles of the mouth, about the nares, auricles, and anus. When the skin is dry and sensitive, exposure to cold and wind, or the action of soap and water may produce fissures—"chapping." Pain often accompanies movement of the parts by opening or deepening the cracks or forming new ones.

Crusts (Scabs, Crustae).—Crusts are dried masses of serum, pus, or blood, usually mixed with epithelial and bacterial débris. They vary greatly in size, thickness, shape, and color according to their origin, composition, and the amount of discharge. They may be dry, soft, friable, and superficial, as in impetigo contagiosa, yellowish, as in favus; or thick, hard, and tough, as in third degree burns, or lamellated, elevated, brownish, blackish or greenish masses as in late syphilis. The latter have been described as oyster-shell shaped crusts (ostraceous) and are known as *rupia*. When thin crusts become detached, the base may be dry, or red and moist, and heal, leaving a smooth normal skin surface. Lesions with thick crusts covering ulcers are likely to leave scars.

Ulcers (Ulcera).—These are rounded or irregularly shaped, destructive excavations. They vary in size from that of a split-pea to several inches in diameter. They may be shallow, involving only the epidermis, as in some cases of lupus and epithelioma, the base being formed by the papillary layer, or they may extend deep into the corium or even reach into the subcutaneous structures, as in rodent ulcer or a broken-down gumma.

Ulcers occur more commonly where the resistance of the skin is low, as in legs affected by varicose veins or eczema, or where the nerve supply is impaired (in connection with spinal disease and leprous neuritis). They may heal spontaneously, be more or less stationary, or be progressive for a time. As in most instances where connective tissue is involved, cicatrices are formed.

Syphilitic ulcerations are characterized by a punched-out appearance, the walls descending abruptly at right angles to the skin surface, and by a base covered with a thick, sticky exudate. Rupial crusts may cover the lesion. The edge is usually indurated, and rarely it may be undermined, a characteristic seen mostly, however, in tuberculous ulcers, which have a floor covered by dirty, stringy material, and are likely to be painful, in contradistinction to luetic lesions. Ulcers produced by carcinoma do not often have much inflammation about them, and are likely to have definite signs of the neoplasm in the hard raised edges, and a base covered with friable granulation tissue which bleeds readily. Traumatic and self-inflicted ulcers are usually superficial and linear, have clean granulating bases, and are upon locations accessible to the hands. Varicose ulcers occur upon the lower third of the legs, are more or less superficial and are accompanied by varicose veins and often by eczema.

Scars (Cicatrices).—Scars are new formations of connective tissue which replace loss of substance in the corium or deeper parts as a result of injury or disease. They are well supplied with blood capillaries and nerves. Their size and shape are determined by the form of the previous destruction. In certain dermatoses the process of absorption of cellular infiltration leads to scar formation, as in lupus and syphilis. In others, pressure leads to thin, atrophic scars or the fibrous elements develop into neoplastic overgrowths, as in keloid. Cicatrices may be smooth or rough, pliable or firm, and tend at first to be pink or violaceous, later becoming white and glistening, and rarely pigmented. Scars with certain characteristics are typical of individual diseases of the skin so that they are of diagnostic value. Those of lupus erythematosus are shiny, thin, rigid, telangiectatic and minutely pitted, corresponding to glandular orifices; those from lupus vulgaris, tough and fibrous, occasionally cordlike or with scaling at the edges; those which follow burns are a mixture of thin, depressed, atrophic and hypertrophic, raised or fibrous lesions with keloidal tendency; those of smallpox, innumerable small white rounded pit-like depressions, usually on the face; those which follow the involution of syphilides are thin, crinkled, and translucent, while those of keloid spread in a clawlike manner.

Scars are persistent but nevertheless are inclined to become less noticeable in the course of time. On the other hand, sometimes they grow thick, tough and corded; rarely the hypertrophic scar tissue may spread into the neighboring normal skin, forming keloids.

Distribution and Arrangement of Lesions.—Lesions may be few or numerous, and they may be discrete, or coalesce to form patches or peculiar configurations. They may appear over the entire body, usually following lines of cleavage of the corium, they may follow the course of nerve trunks, as in herpes zoster and leprosy, or they may form groups, rings, crescents, or grotesque patterns. Lesions may be symmetrically distributed, or asymmetrically, the latter pointing to a local cause. Such features are suggestive of specific affections. Certain regions are more susceptible to some diseases than others, as the face in acne and rosacea, the scalp in seborrheic dermatitis, the extensor surfaces in psoriasis, the chest and back in tinea versicolor, and the trunk in pediculosis corporis. Further details concerning the distribution and arrangement of lesions are given under Diagnosis.

GENERAL DIAGNOSIS

Interpretation of the clinical picture is rendered difficult, for identical manifestations may result from widely different causes. Moreover, the same etiologic factor may give rise to a great diversity of eruptions. However, there is one great advantage in dermatology, namely, that of dealing with an organ that can be seen and felt. Smears and cultures may be readily made for bacteria. By excision and microscopical examination of the lesion, its histopathology can be studied in relation to the clinical appearance, more directly in the skin than elsewhere. A skin disease in its various stages of development can be inspected, palpated, and studied without dependence upon percussion, auscultation, and other indirect diagnostic methods necessary in other branches of medicine.

Importance of the History.—Claim has been made that histories are often misleading if taken prior to the examination of the skin eruption. While there may be some basis for this assertion, it has done more harm than good. The adherents to this policy soon become lazy and their cases are not thoroughly worked up, because a good history is not successfully elicited after the examination has been made. In the consultation the chief aim is the relief of the patient, and not the assigning of a name to his skin disorder, for many dermatological terms have little real value. All facts contributory to a knowledge of the patient's family, his health, occupation, living conditions, the onset and course of the disease, and its response to previous treatment are as pertinent in dermatology as in internal medicine.

The manner of the appearance of the disease, its course, and its duration may assist in diagnosis, but too much importance should not be attached to the naming of it. A complete history is of more value than simply serving in the diagnosis. Whereas a history may be superfluous for the diagnosis, or even for the treatment and cure, of easy cases, it is the backbone of treatment in difficult ones. That the patient with eczema had asthma due to ragweed, and that the syphilitic had an attack of sleeping sickness are examples of important facts missed by those who are careless in the taking of histories. The chronic dermatoses are the most distressing to both the patient and the physician, and form the bulk of dermatological practice. For the analysis and identification of the cause of the disease, for cognizance of those remedies which have been beneficial and those harmful, for intelligent treatment of the chronic case, a good history is essential, and the degree of improvement that the patient ultimately shows is usually proportionate to the quality of the protocol.

The history should be systematically arranged, with abbreviations as numerous as clarity permits, all pertinent facts being included, important statements underlined, and irrelevant matters omitted. The wearisome taking of long histories is a hardship, so dispatch and thoroughness in essential data are necessary. It is the problem of the history-taker to direct and keep the patient's thoughts in productive channels, and to make clear notes without interrupting or distracting him.

Duration.—The factor of time is important as a supplementary aid in the diagnosis of various cutaneous diseases, especially in lupus, syphilis, and epithelioma. Lupus vulgaris usually begins in childhood and is, therefore, of long duration. Tertiary syphilitic skin lesions commonly exist three to six months, although occasional instances of many years' duration are still seen. Basal-cell epithelioma is generally of several years' growth, and of slow evolution in elderly subjects. Squamous-cell epithelioma occurs in younger individuals and grows more rapidly, usually having a duration of about a year.

Some affections are acute, appearing suddenly and involuting spontaneously, as urticaria and herpes zoster, while others have a tendency to be chronic as lupus erythematosus and ichthyosis. If an eruption has been present for some time, a transitory disease can be precluded unless it has been fed by a continuance of the causative factors. Eruptions associated with febrile diseases and those from psychical disturbances may last only a few days. Those of several weeks' duration are comparatively few in number although of common occurrence. The course of certain chronic diseases is variable, periods of improvement being intermittent with fresh outbreaks.

Other Factors.—Such factors as race, age, sex, and occupation may have some weight in diagnosis. Certain diseases occur more commonly in children, as papular urticaria, infantile dermatitis, and ringworm of the scalp; others are likely to appear more frequently in adolescence, as lichen planus; while still others appear in old age, as senile keratosis. Paget's disease, erythema induratum, and lupus erythematosus occur more frequently in women; and epithelioma in men.

Examination.—Examination of the patient should be conducted in a well-lighted room. Daylight is a necessity for successful dermatological practice, but some eruptions are more clearly visible in ultraviolet light, as in the case of faint macular eruptions, which then become prominent. In tinea capitis the use of ultraviolet light passed through Wood's filter, which is permeable to wavelengths of about 3650 Å. U., is of assistance in diagnosis, for the spores become fluorescent in these rays.

The manner of display of the diseased areas is important. The entire eruption must be seen in order that such factors as distribution and configuration can be studied, as they are of valuable assistance in the recognition of the disease, and for prescription of treatment for the areas involved. The exercise of tact and personal consideration is highly rewarded by winning the patient's confidence, so that the skin examination can be as complete and detailed as the case demands. Skill in the diagnosis of the vast number of cutaneous affections can be acquired only by careful and patient observation and by experience. Some are easily recognized, while others being ill-defined and strangely variant demand the closest observation and complete knowledge of all factors.

The beginner must consciously remember to make observations which are automatically done by the experienced clinician. With the naked eye, the extent and distribution of the eruption and its predilection for certain regions are first noted. Then the principal characteristics of the eruption are observed, viz., whether it is grouped, configurate, segmental, unilateral, and whether the visible lesions are secondary or primary, uniform or polymorphous. The individual lesions, especially the primary ones, are then studied as to color, shape, and size. By palpation it is next determined whether the lesions are elevated or not, whether they are smooth or rough, soft, fluctuant, compressible, pulsating, elastic, firm, or hard. The finer details of selected lesions are observed through a hand magnifying glass, and after this, diascopic examination may be indicated to ascertain the appearance of the exudate in the corium.

Not all dermatoses are manifested by eruptions of papules, vesicles and the other kinds of skin lesions. Some affections are made up of alterations in the color of the skin, or of trophic disturbances in the skin or its appendages—the hair, nails, and glands.

The diagnosis and treatment of the skin eruption are often assisted by a knowledge of the general physical condition of the patient. To this end, physical examination is frequently made. It is superfluous and should be omitted in selected instances, but should be routine in all patients who are suffering from diseases of unknown or internal cause, in all syphilitics, and in all who are to receive intravenous injections. The examination should include a search for focal infections, a study of the eyegrounds and neurological tests.

Laboratory tests may be necessary to complete the study of the case. These may be such routine examinations as a urinalysis, blood count or blood Wassermann, or special studies of blood chemistry, of the stool, of the serology, biochemistry and allergy, of the bacteriology and histology of the lesion, or an examination of the cerebrospinal fluid.

Diagnostic Details of Lesions.—*Evolution.*—Some lesions quickly attain complete formation without any intermediate stage (macules). Certain others remain the same (warts) during their entire existence. Other lesions develop into different primary lesions, as the papulovesicles becoming pustules, and may be present in all stages of evolution. Some lesions show marked alterations, due to conglomeration or confluence.

Involution.—Certain lesions disappear completely, whereas others leave pigment or scars, and still others do not involute.

Grouping.—Certain lesions tend to be grouped in clusters, as in herpes zoster; or in a concentric manner, as in erythema iris. Grouping is a characteristic of late secondary and of tertiary syphilitic eruptions. In dermatoses due to bacteria and fungi, a cluster of lesions may be the result of the development of small new ones around the original lesion by the spreading of infection.

Configuration.—There is a tendency in some lesions to assume characteristic figures, either by enlargement or by coalescence. Circinate and annular lesions are encountered in ringworm, syphilis, erythema multiforme, lichen planus, psoriasis, seborrheic dermatitis, and pityriasis rosea. Gyrate patterns are formed in psoriasis, mycosis fungoides, and sometimes in syphilis. Serpiginous arrangement is a characteristic of tertiary syphilis of the skin and occasionally of rodent ulcer. In some syphiloderms and in the configurate type of seborrheic dermatitis, there are crescentic formations. Some grotesque and bizarre patterns are found in mycosis fungoides and in lymphosarcoma cutis.

Color.—It is not advisable to place too much reliance on the color of lesions as a diagnostic factor, for it is difficult to describe colors, and they appear differently to different individuals; but they may at least serve as a corroborative aid. The character of the color, the brightness or depth of the red, may add a distinctive quality to the lesion in inflammatory diseases, as for instance the brilliant red of erysipelas and scarlet fever. However, lesions in the same eruption may vary considerably and at different stages of development, and the same type of lesion in different individuals may show variations.

Lesions lighter in color than the normal skin suggest leukoderma, and when mottled about the neck, syphilis. Patches of seborrheic dermatitis in negroes may be light in color, and chromophytosis in brunettes may produce a semblance to white spot disease, morphea guttata, or lichen sclerosis. Leprosy, scleroderma, and cicatrix may produce lesions lighter in color than the normal skin. Lesions darker in color may be inflammations, nevi, lentigo, or hyperpigmentations—such as occur in chloasma, accompanying scars, from pressure or rubbing, due to arsenic, or to bismuth or lead on the gums; or when generalized and profuse, as a sequel of lichen planus.

Type of Eruption.—The lesions of a certain disease may be preponderantly of a characteristic type. Where they are distinctly macular or papular, correct diagnosis is made reasonably certain. In many affections and in different stages of the same affection the lesions may be modified in size, shape, and color, or associated with other outstanding features that render diagnosis more difficult. The various types in their common occurrence will be briefly considered.

Of the *erythematous eruptions,* the common form of *macules* may be found in eczema, erythema simplex, erythema multiforme, erythema intertrigo, dermatitis from chemical irritants, of plant origin and those due to toxins. The circumscribed, usually pink or reddish patches may be oozing and scaling as in eczema erythematosum, or they may show edematous swelling and well-defined edges, associated with constitutional symptoms as in erysipelas.

Widespread macular eruptions are encountered in syphilis, chromophytosis, measles, scarlet fever, toxic erythema, drug eruptions, pityriasis rosea, and in seborrheic dermatitis.

Among the common *papular eruptions* are eczema (perhaps associated with edema and a tiny vesicle on the apex), prickly heat, milium, papular syphiloderm, papular urticaria, and erythema multiforme. The papules may have horny plugs as in keratosis pilaris and lichen spinulosus, or they may be follicular, scaly, and tend to coalesce into sheets as in pityriasis rubra pilaris, or just scaly as in psoriasis; or they may be associated with subjective symptoms as in prurigo and miliaria.

Flat or rounded papules occur in erythema multiforme, usually on the backs of the hands, on the forearms and face; in psoriasis, where they are confluent and scaly; in syphilis, where they are usually widespread, scaly, and nonpruritic, and in the exanthemata. The papules of lichen planus are distinctive, being angular, violaceous, flat, dry, and umbilicated and arranged in rows. In keratosis pilaris and syphilis, and sometimes in eczema, scabies, and smallpox, the papules may be acuminate.

Characterized as *nodular eruptions* are such lesions as acne (usually also pustular), erythema nodosum, iododerma, and the tubercular syphiloderm. Nodules occur in leprosy and yaws. In rosacea they are associated with hyperemia and telangiectasis, while in lupus vulgaris they tend to ulcerate. Nodules may show configuration, changes in pigment, or cause atrophy and scar formation.

In eczema, herpes simplex, herpes zoster, dermatophytosis, dermatitis herpetiformis, sudamina and impetigo contagiosa there occur *vesicular eruptions*. Burning and itching are often present, and the vesicles tend to rupture spontaneously, as in eczema, or may involute without rupturing, as in miliaria and herpes zoster. Erysipelas may show vesiculation. The discrete and confluent vesicles of dermatitis venenata generally develop into bullae. Vesicles also occur in chickenpox, scabies, and dermatitis medicamentosa.

Squamous eruptions are often combined with other forms, as in eczema and psoriasis. In acute inflammatory conditions with edema in the epidermis, scaliness is present as a rule. It may be marked as in seborrheic dermatitis, or slight as in ringworm of the scalp, loose or adherent, whitish, silvery or grayish. In ichthyosis, pityriasis rosea, and dermatitis exfoliativa the scaliness varies in degree. Desquamation may consist of light flaky scales (in pityriasis sicca), or thin greasy ones (dermatitis seborrhoeica), or of thick scaly plaques (psoriasis) or of large sheets (after scarlatina).

In association with the ordinary symptoms of erythema multiforme there may be a regional *bullous eruption*. In impetigo contagiosa many of, and rarely all, the lesions are distended and typical bullae. Scalds and burns, dermatitis venenata, and drugs as iodides may be direct causes. In dermatitis herpetiformis the blebs are grouped and associated with itching; in pemphigus they appear to arise from healthy skin, with systemic derangement. Bullae in congenital syphilis are usually limited to the palms and soles, and are associated with other evidences of the disease.

Among *pustular eruptions* that of acne vulgaris is most common. The pustules are upon the face and back and are associated with comedones, sometimes leaving small pitlike scars. In furunculosis the pustule rapidly develops an inflammatory indurated base. Vesicles may precede the pustules as in impetigo contagiosa, and may be combined with them as in scabies. Certain pustular lesions are found in connection with the hair follicles as in pustular folliculitis; acne varioliformis; ringworm of the scalp, and beard; eczema of the face, thighs, and other regions; and in sycosis vulgaris. Drug eruptions may be characterized by pustules. In negroes with syphilis, pustular lesions are fairly common. A pustular dermatitis is often associated with pediculosis. Constitutional symptoms may be present as in variola, or pain and tenderness as in furunculosis and ecthyma.

Some lesions, principally of syphilis, epithelioma, lupus vulgaris, and other varieties of cutaneous tuberculosis, are *ulcerative.* Both furunculosis and carbunculosis may involve some destruction of tissue. Ulceration is common in erythema induratum and in association with varicose veins, and it is usually present to some degree in blastomycosis and actinomycosis. Ulcers may be traumatic in origin, sometimes being self-inflicted.

Whereas most tumors are single discrete neoplasms, others may be multiple and of more or less extensive distribution—as in fibroma, granuloma fungoides, nevi, molluscum contagiosum, sarcoma and leprosy. When they are cystic, fluctuation may be present. Tumors are often overgrowths of certain tissue constituents, as lipoma and xanthoma of adipose tissue; neuroma of nervous elements, and keloids of fibrous connective tissue. Some tumors have infiltrated bases, become adherent to underlying structures, ulcerate, or metastasize through lymph or blood channels, or invade neighboring structures by direct extension.

Crusts are seen in connection with various vesicular, bullous, pustular, and ulcerative conditions, as eczema, impetigo, ecthyma, and syphilis.

Warts, warty growths associated with various diseases as staphylococcic infections, tuberculosis, blastomycosis, carcinoma, elephantiasis, and syphilis may be grouped as *papillomatous eruptions.* They may also be the result of the ingestion of certain drugs—bromides, iodides, and arsenic.

Where there has been injury or ulceration involving complete destruction of the epidermis and papillary layer of the corium (as in leprosy, tertiary syphilides, epithelioma, lupus erythematosus, and pyogenic infections), *cicatricial* or *atrophic conditions* may result. There may be an atrophic thinning as in lupus vulgaris or deep destruction producing a gouged-out or pitted appearance as in smallpox.

Pigmentation may occur as a single symptom or in association with others, with or without textural change, transient or more or less permanent, and ranging in color from light yellow to dark brown. It may be mild and on exposed parts as sunburn, a profuse pigmentation due to the actinic rays, or brownish macules as freckles. Changes in pigmentation may constitute the affection itself as in vitiligo, or may be an integral part as in the slate-colored spots of the phenolphthalein eruptions, the yellowish-violet lesions of urticaria pigmentosa, the dark hairy thickenings of nevus pigmentosus, the warty pigmented patches of acanthosis nigricans in the axillae and groins, the telangiectatic, warty and epitheliomatous growths of xeroderma pigmentosum; or may be dependent upon systemic disturbances as in chloasma and Addison's disease. Discoloration appears in lesions of hemorrhagic origin as in bruises, purpura, and about varicose ulcers. In some instances, it is more a sequela of involution as occasionally in the macules and patches of lichen planus, and in syphilis following the healing of ulcerations.

Regional Predilection.—Although not always of definite diagnostic value, regional predilection may be of corroborative aid. There are certain affections of the skin that are found almost exclusively in definite regions as rosacea on the flush areas of the face, erythema multiforme on the backs of the hands, arms, and face, and tinea barbae of the bearded region. Other conditions are more common on certain areas as acne of the face, neck and shoulders, lupus erythematosus of the face, and seborrheic dermatitis and ringworm on the scalp. Pityriasis rosea, chromophytosis, scabies, and pediculosis corporis are usually limited to the trunk and extremities, without involvement above the neck. Nearly every dermatosis has regional predilections, which constitute an important diagnostic feature in the clinical picture. Appended is a list of common skin diseases arranged according to regional predilection.

Scalp.—Seborrheic dermatitis, psoriasis, eczema, depilating folliculitides, furunculosis, alopecia of various kinds, warts, sebaceous cysts, lupus erythematosus, carcinoma, melanoma and, more in children, ringworm, favus, pediculosis, and impetigo.

Ears.—Eczema, secondary to scalp involvement, dermatitis due to hair dye, impetigo associated with pediculosis capitis, lupus erythematosus, frostbite, lupus vulgaris, keratoses, basal-cell or squamous-cell carcinoma, more often the latter, and leprosy.

Face.—Acne, dermatitis seborrhoeica, dermatitis venenata, milium, molluscum contagiosum, impetigo, furuncle, erysipelas, rosacea, lupus erythematosus, lupus vulgaris, syphilis, keratosis, carcinoma, nevi, herpes simplex, herpes zoster, eczema, erythema multiforme, chloasma, lentigo, vitiligo, radiodermatitis, warts, leprosy, actinomycosis, ringworm, hydroa vacciniforme and drug eruptions.

Eyebrows.—Seborrheic dermatitis, alopecia areata, myxedema, syphilis, sycosis vulgaris, and hypertrichosis.

Eyelids.—Xanthelasma, eczema, dermatitis venenata, milium, and rodent ulcer.

Nose.—Keratoses, carcinoma, rosacea, furuncle, lupus erythematosus, and tertiary syphilis.

Lips.—Herpes simplex, eczema, angioneurotic edema, sycosis vulgaris, sporadic elephantiasis, chancre, Fordyce's disease, cheilitis exfoliativa, and cheilitis glandularis, leukoplakia, lupus erythematosus, erythema multiforme, keratoses, carcinoma—upper lip usually basal-cell and lower lip nearly always squamous-cell type.

Bearded Region.—Staphylococcic sycosis, ringworm, impetigo, alopecia areata, hypertrichosis, eczema, carcinoma, sebaceous cyst.

Neck.—Furuncle, carbuncle, ringworm, seborrheic dermatitis, neurodermatitis, tinea versicolor, syphilitic leukoderma, pellagra, dermatitis papillaris capillitii, scrofuloderma, keloid, dermatitis due to dye in fur collars, carcinoma.

Chest.—Seborrheic dermatitis, acne, keratoses, herpes zoster, tinea versicolor, pityriasis rosea, eczema, psoriasis, syphilis, scleroderma, keloid, infectious eczematoid dermatitis.

Abdomen.—Scabies, syphilis, pityriasis rosea, tinea versicolor, eczema, pediculosis corporis, herpes zoster, urticaria, lichen planus, exanthemata, and drug eruptions.

Back.—Acne, syphilis, herpes zoster, eczema, pityriasis rosea, pediculosis corporis, tinea versicolor, psoriasis, seborrheic dermatitis, keratoses, carcinoma, usually basal-cell type, and dermatitis herpetiformis.

Buttocks.—Acne, furuncle, scabies, syphilis, eczema, urticaria, scrofuloderma, and dermatitis herpetiformis.

Gluteal Crease and Anus.—Pruritus, seborrheic dermatitis, dermatophytosis, eczema, psoriasis, condyloma latum, condyloma acuminatum, granuloma inguinale.

Genitalia.—Chancre, chancroid, condyloma acuminatum, herpes simplex, scabies, lichen planus, pruritus, pediculosis pubis, dermatitis venenata, and epithelioma.

Groins.—Tinea cruris, pityriasis rosea, seborrheic dermatitis, intertrigo, psoriasis, furuncle, pemphigus, pediculosis corporis, granuloma inguinale, Fox-Fordyce disease, molluscum contagiosum.

Thighs.—Scabies, urticaria, eczema, psoriasis, ecchymosis, parapsoriasis, keratosis pilaris, and exanthemata.

Legs.—Lichen planus, prurigo, pruritus, erythema nodosum, erythema induratum, varicose ulcers, varicose eczema, purpura, syphilis, elephantiasis, psoriasis, Kaposi's sarcoma, and leprosy.

Feet.—Dermatophytosis, plantar warts, arsenical keratoses, hyperidrosis, frost-bite, eczema, psoriasis, syphilis, leprosy, callus, corn, Kaposi's sarcoma, melanoma, and in infants, scabies.

Hands.—Dermatophytosis, warts, scabies, furuncle, occupational dermatitis, dermatitis venenata, infectious eczematoid dermatitis, eczema, erythema multiforme, hyperidrosis, erysipeloid, leukoderma, pellagra, granuloma annulare, syphilis, radiodermatitis, keratoses, carcinoma, and leprosy.

Forearms and Wrists.—Dermatitis venenata, occupational dermatitis, pellagra, warts, scabies, erythema multiforme, lichen planus, prurigo, blastomycosis, sporotrichosis.

Elbows and Knees.—Psoriasis, neurodermatitis, xanthoma, scabies, ichthyosis, acrodermatitis chronica atrophicans, subcutaneous fibrotic gummas, and epidermolysis bullosa.

Axillae.—Ringworm, furuncle, molluscum contagiosum, Fox-Fordyce disease, hyperidrosis, seborrheic dermatitis, intertrigo, pityriasis rosea. scabies, erythrasma, and infectious eczematoid dermatitis.

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CHAPTER IV

CLASSIFICATION AND TERMINOLOGY

CLASSIFICATION

No one will deny that the classification of diseases of the skin is unsatisfactory. The earliest important attempts at a classification were those of Plenck and Willan. As was to be expected, these first efforts were based upon the general appearance of the local lesions.

Plenck (1732–1807) followed the general lines laid down by Linnaeus, and suggested the following classification:

1. Macules.
2. Pustules.
3. Vesicles.
4. Bullae.
5. Papules.
6. Crusts.
7. Scales.
8. Callosities.
9. Excrescences.
10. Ulcers.
11. Wounds.
12. Cutaneous Insects.
13. Diseases of Nails.
14. Diseases of Hair.

Willan (1757–1812) improved on the plan of Plenck, and gave the following classification:

1. Papules.
2. Squamae.
3. Exanthemata.
4. Bullae.
5. Vesicles.
6. Pustules.
7. Tubercles.
8. Macules.

This is generally recognized as the starting point of modern dermatological classification. From the point of view of diagnosis these two methods had some advantages; but they failed to indicate the pathology, etiology, and plan of treatment.

The next step was the method of Erasmus Wilson (1810–1884), who was well known as an anatomist. Naturally he favored an outline based upon the anatomical structure of the skin. His scheme was as follows:

- I. Diseases affecting the General Structure of the Skin:
    1. Diseases arising from General Causes.
    2. Diseases arising from Special External Causes.
    3. Diseases arising from Special Internal Causes.
    4. Diseases arising from the Syphilitic Poison.
    5. Diseases arising from Animal Poisons of Unknown Origin.
- II. Diseases affecting the Special Structure of the Skin:
    1. Vascular Structure.
    2. Nervous Structure.
    3. Papillary Structure.
    4. Pigmentary Structure.
    5. Sudoriparous Organs.
    6. Sebiparous Organs.
    7. Hair Follicles and Hair.
    8. Nail Follicles and Nails.

The third stage in the development of the classification of skin diseases was the general recognition of the importance of the study of pathology. It was upon this basis that Hebra (1816–1880) made his classification:

1. Hyperemias.
2. Anemias.
3. Anomalies of Secretions of Glands.
4. Exudations.
5. Hemorrhages.
6. Hypertrophies.
7. Atrophies.
8. Neoplasms.
9. Pseudoplasms.
10. Ulcerations.
11. Neuroses.
12. Diseases caused by Parasites.

Hebra's classification has been practically adopted as the basis of all subsequent classifications. Of course modern dermatologists have modified and enlarged Hebra's outline, but a glance through any of the more recent textbooks of dermatology will reveal much of Hebra's plan.

E. B. Bronson, in 1887, published a scholarly and scientific outline, but it has proved to be too elaborate and academic for general use.

The most satisfactory classification would be one based upon the etiology of the various diseases of the skin, but at present this is impossible. However, there is no reason why the existing classifications should not be modified on this basis as the etiology of the different dermatological lesions is ascertained.

It remains to note that the American Dermatological Association, recognizing the apparent impossibility at present of securing a satisfactory classification has adopted the method of alphabetical arrangement. This arrangement, while admirable for ready reference (provided the name of the disease is known), is entirely unsuited for purposes of study.

The classification used in this book is a combination of those of Hebra and of Wilson, special prominence being given the commoner dermatoses. The reader will not find it academic, but, I hope, will feel that it is in the main simple and easy to use.

TERMINOLOGY

If the classification of skin diseases is unsatisfactory, the terminology is even more so. Most of the diseases have a Greek or Latin name, which is often qualified by one or more adjectives (also in Latin). To the student with "small Latin and less Greek" this combination presents a difficulty which is well nigh insuperable. Unfortunately this is only the beginning of his troubles. Dermatological lesions are frequently known by several different names, some of them accurately denoting the condition, and some not. Added to these difficulties is the presence of proper names, introduced to commemorate the name of the discoverer or describer of the disease. It is a conservative estimate that 90 per cent of the synonyms could be abolished without any appreciable loss to medical science in general or to dermatology in particular.

Gender of Commonly Used Latin Words.—As a help to the student in adding the correct adjectival form to the Latin or Greek noun, a list of the more commonly used nouns, with their gender, is appended:

Masculine are: Cimex, Herpes, Lichen, Lupus, Nevus, Pemphigus.

Feminine are: Acne, Alopecia, Atrophia, Dermatitis, Dermatophytosis, Ichthyosis, Impetigo, Keratosis, Macula, Onychomycosis, Pityriasis, Prurigo, Psoriasis, Purpura, Seborrhoea, Stria, Tinea, Trichorrhexis, Tuberculosis, Urticaria, Verruca, Verruga.

Neuter are: Adenoma, Angioma, Atrophoderma, Carcinoma, Chloasma, Cornu, Ecthyma, Eczema, Epithelioma, Erythema, Granuloma, Hydroa, Lymphangioma, Molluscum, Edema, Sarcoma, Xanthoma.

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CHAPTER V

PRINCIPLES OF TREATMENT

The skin should not be regarded as a separate entity, but as an important organ which is closely related to the general economy. The same principles of treatment are used in diseases of the skin as in those of other organs. Treatment is based upon a knowledge of the etiology, the origin, the development of the affection, and of the therapeutic action of the different local and general remedies. If, as happens in some cases, the etiologic factor or factors are not discoverable, reliance must be placed upon the symptomatic treatment of the clinical manifestations and underlying pathologic changes, and upon therapeutic management which has proved of service empirically. In addition, it is essential to study the patient as an individual, to ascertain the general state of health, the patient's environment, and to investigate the various systems, as the blood, circulatory, nervous, reproductive, and especially the gastro-intestinal and urinary, and to search for special peculiarities and idiosyncrasies, or reactions to remedies. On account of advances in blood chemistry studies, immunology, chemotherapeutics, endocrinology, and studies of the vegetative nervous system, systemic treatment receives more than ordinary attention. Cure, if attainable, should be effected as soon as possible, as there is no danger of "driving the eruption in." This is a common fear of the ignorant, which has no foundation. The chief danger of too vigorous treatment is that it may cause an irritation and spreading of the eruption.

In most cutaneous diseases both external and constitutional measures are required, particularly in those cases involving a general disorder. Systemic treatment is given for the purpose of increasing the resistance of the tissues, diminishing the virulence of the infection and improving the general health. In some instances, however, such as purely local affections, external remedies suffice for a cure. Other diseases tend to have a self-limited duration and require few actual therapeutic measures. Still others can be only temporarily improved, when the patient should be apprised of the fact.

GENERAL MANAGEMENT

The state of health or physical well-being influences the tone of the skin. Any factor which affects the body as a whole has an indirect bearing on the skin disease. Food poisons, auto-intoxication by the absorption of toxins resulting from fermentative processes, disorders of the liver, blood derangements, such as anemia and diabetes, circulatory disturbances, and dysfunction of the kidneys may be responsible for certain skin affections. Consequently, control of these disorders must be undertaken to lessen and modify the cutaneous diseases. If local symptoms require topical therapy, it should be employed even if the systemic treatment proves of benefit. Certain conditions may exist which contra-indicate the use of an internal remedy.

Overcrowded, **unsanitary conditions** are responsible for a large number of skin affections among the poor. In such circumstances, in order to obtain a cure it is necessary to remove the patient to a hospital where he can have skilled care, ventilation, and proper food. Hygienic living, plenty of fresh air, sunshine, a suitable amount of outdoor exercise, well-ventilated sleeping quarters, proper rest, and diet are all to be regarded as having therapeutic value. Where the affection involves covered parts of the body the **clothing** should be light, loose, and warm. Rubbing against the part, or constriction, must be avoided. The underclothing must be smooth, soft and absorbent, linen or lawn being used beneath a warmer material. Pure wool is irritating to sensitive skin and against affected surfaces, and should be discarded in favor of silk and wool combined. The form of **occupation** may be a direct or indirect cause of certain eruptions, such as dermatitis resulting from the handling of chemical irritants or those associated with sedentary occupations or prolonged exposure to continued inclemency of the weather. It may be impossible in such cases to effect a cure without a change of employment; a return to the same environment may induce a recurrence.

In certain affections of the skin, especially acute, widely distributed dermatitis and in intractable chronic cases, **rest** in bed contributes to improvement in no uncertain degree. Almost as important as physical rest is mental ease—freedom from care, worries and overwork, which may even be imperative in certain cases. The strain on the functional activity of the skin, and much irritation from compression and rubbing may be eliminated. The application of local remedies may be more easily made. Local rest of the part, as in ulcer of the leg associated with varicose veins, is essential to cure. Continued activity may delay alleviation of the malady indefinitely.

Climate is of more importance in the management of certain skin affections than one would at first suppose. Certain diseases are more common in a hot tropical atmosphere, while others are to be found more frequently in cold countries. Wind and dampness may aggravate affections on exposed parts, and a warm climate may prove beneficial. The value may lie in change of environment to different scenes, cessation of worry, and occupation and outdoor exercise rather than in the temperature change and atmospheric conditions.

Skilful **nursing** is likely to accelerate a cure. Local remedies must often be persistently and regularly applied to be effective, baths must be given, and dressings changed.

The value of **diet** may be overestimated as a responsible factor. Its direct bearing on cutaneous diseases cannot be readily detected, but that some foods are capable of inciting certain eruptions of the skin and aggravating others has passed beyond the domain of doubt. The average individual partakes of too much food of high caloric value, drinks too little water, eats too hurriedly, and fails to masticate his food properly. Indulgence in condiments, spices, and stimulants should be forbidden. Certain foods in some individuals may produce auto-intoxication by the absorption of toxins resulting from putrefactive or fermentative processes occurring in the large intestine.

Constipation must be relieved, sweets and carbohydrates restricted, and the use of alcohol and tobacco regulated. Any article of food to which the patient shows an intolerance must be abolished from the diet. Certain people are hypersensitive to some food products. A bland diet is recommended as a safe and advisable procedure. Such articles of food as the following have often been found to be harmful: Shellfish, especially in warm weather, oily fish, mackerel and sardines, canned meats, high game, indigestible meats, as veal and pork, cheese, pastries, acid fruits, especially strawberries, and highly seasoned dressings. Regular and thorough evacuation of the alimentary canal can be best accomplished by uniform habit, copious drinking of water and by the use of a cathartic. In those cases in which constipation is habitual the institution of exercise or massage, and a diet of abundance of green vegetables, fruit, and some food articles to give bulk, are recommended. Increased activity of the kidneys, as well as of the intestinal tract, influences the eruption.

INTERNAL THERAPY

For the most part, internal treatment is directed toward removal of the contributing factors which produce or are incidental in continuing the skin affection.

General tonics are used in certain diseases of the skin in which debility is apparent. When nutrition is not normal, due to vitamin insufficiency, cod liver oil, tomato juice, and yeast are beneficial. In anemic conditions, liver, iron, manganese, quinine, strychnine, the iodides, arsenic in small doses, and the hypophosphites are effective remedies. The ordinary bitter tonics stimulate a lagging appetite and aid digestion.

A saline **aperient** (such as sulphate of sodium or magnesium) is advisedly prescribed as a preliminary to the treatment of any acute inflammatory eruption. The cutaneous congestion is relieved, general irritation is reduced by emptying the bowel and producing an increase in transudation of fluid from the blood vessels. The **vegetable laxative preparations,** especially rhubarb or cascara, often give satisfactory results. Enemas and colonic irrigations have their place as temporary measures. In case of sluggishness of the liver, calomel in small doses followed by a saline aperient is recommended.

I have found the following form of printed slip useful in the regulation of alimentary elimination, the blank being filled in according to the individual requirements.

Daily fluid intake to be at least — quarts.
Diet (prescribed).
Exercise (specific instructions).
Abdominal massage.
Cellulose products (agar, bran).
Mineral oil, — dessertspoonfuls daily.

Olive oil, 1 cup, warm, should be inserted into the rectum at bedtime with small catheter while patient is recumbent. Effort should be made to retain it all night.

Castor oil, 10 drops in capsules after each meal.

Suppositories, enemas of soapsuds, glycerin; colonic irrigations (frequency — times weekly) preceded by small soapsuds enema, with saline, tap water, sodium bicarbonate (or special formula) to the quart.

Total amount to be given: — gallons, until return flow is clear.

Implantations— Vaccine—

Frequency:

High colonic irrigations have been found very useful by the author in patients suffering from mucous colitis, or intestinal fermentation or putrefaction.

As these irrigations are given in manifold ways by various nurses, one gains the impression that the degree of benefit derived from them is dependent upon the thoroughness and skill of the nurse. It is recommended that two tubes, consisting of an inlet and outlet, should be utilized, and that the irrigation should be continued until the return flow is clear. This usually requires between 3 and 6 gallons of fluid, normal saline solution or a weak solution of sodium bicarbonate being used. It is advisable to precede each irrigation by a small soapsuds enema. The patient should lie on the left side, and no excess fluid should be left in the colon at the completion of the irrigation. If the treatment is done properly, it should be followed by no pain or desire to defecate. The latter are usually caused by leaving water in the intestines. Some cramps, however, cannot be avoided in cases where flatulence is pronounced.

The benefit from mineral waters is to be regarded as originating more in their mild laxative and diuretic properties than in any specific effect on the skin. Potassium acetate, sodium acetate, sodium citrate, and potassium bicarbonate are probably the best of the alkaline **diuretics,** although sodium salicylate, ammonium salicylate, and other similar compounds are occasionally useful. In all instances water should be taken freely, this alone being an effective diuretic.

In cases of extreme nervous irritability, severe pain as in tabes, carcinoma and herpes zoster, and sleeplessness due to incessant itching, sedatives, and analgesics have a distinct though limited field of usefulness. Drugs for these purposes must be used with discrimination and under careful medical supervision. None of them should be administered over a protracted period of time.

In eruptions due to auto-intoxication the so-called **"intestinal antiseptics"** are used. Among these drugs the chief ones are salol and calomel. None of them is distinctly germicidal, and their action is possibly limited to aiding in the prevention of fermentation to some degree by rendering the body and its tissues unfavorable to the growth of micro-organisms. Bacillus acidophilus given in pure culture or in milk together with lactose tends to change the intestinal flora when there is undue ferementation caused by B. coli and similar organisms. Cultures of the lactic acid bacillus are being employed for the treatment of intestinal putrefaction.

The use of **glandular products** or synthetic substitutes for them has a limited value in dermatology. As in the other branches of general medicine, the hormones and extracts from glandular structures have been widely exploited. However, a few preparations are extremely valuable. Thyroid extract is beneficial in myxedema, which involves changes in the skin, hair, and nails associated with a defective internal secretion from the thyroid gland. The remedy is also useful in certain types of alopecia which occur after severe sicknesses or after pregnancy. It has some value in cases of ichthyosis, pernio, and chronic eczema. The dosage of thyroid extract should be small at first ($\frac{1}{4}$ grain t. i. d.) in order that the system may become gradually adapted to it and then any increase in dosage should be made cautiously. The function of the pituitary gland is related to the thyroid, suppression of the latter showing corresponding change in the former. The whole pituitary gland or extracts from it, or extracts from the posterior lobe are given in cases of acne associated with symptoms of hypopituitarism and cases of scleroderma, being often combined with thyroid extract. Little is known of the physiologic effects of the anterior lobe. Suprarenal gland extract is usually given in the form of adrenalin (1 : 1000 glandular extract in 1/10 normal salt solution). This powerful drug has only a temporary action, which may be somewhat prolonged by frequently repeated doses. It is of some transient benefit in attacks of urticaria, angioneurotic edema, and erythema multiforme, being injected hypodermically in doses of 10 to 15 minims. Ephedrine has more lasting effects than adrenalin and has largely supplanted it in dermatology. Ephedrine given in doses of 25 to 50 mg. three times a day is useful in urticaria, erythema multiforme, and angioneurotic edema associated with low blood pressure. Either adrenalin or ephedrine may cause unpleasant nervous apprehension, excitement, and twitching afterward. Adrenal gland substance is sometimes used in leukoderma and other pigmentary disorders although its benefits in these diseases are questionable. In alopecia, rosacea, and eczema, occurring in women between the ages of thirty-five and forty-five, ovarian secretion is occasionally beneficial, especially if a deficiency is indicated by increase in weight, sluggishness, and a decrease in menstruation. The whole gland is used, being preferable to lutein, the main action of which is upon the uterine mucosa. The whole ovarian gland substance is generally combined with small doses of thyroid extract.

Vaccine, Toxin, and Antitoxin Therapy.—The basis of vaccine therapy rests upon the principle of acquired immunity, that is, a stimulation of the production of antibodies by the introduction of an antigen into the body. Both autogenous and stock vaccines are employed, the weight of opinion favoring the former. Stock vaccines may, however, show beneficial results in staphylococcic infections, such as carbuncles and furunculosis. After each injection the immunity is depressed for a time. This is called the negative phase and it is soon followed by a positive phase, during which the production of antibodies is accelerated and the immunity increases to a higher degree than existed before the injection. Tuberculin is employed therapeutically in small doses in some cases of cutaneous tuberculosis. It is not without danger even though the dosage is small and carefully controlled, and its effect is uncertain.

Small immunizing doses of streptococcus erysipelatis toxin and vaccine are effective in overcoming chronic recurrent erysipelas. Erysipelas antitoxin, polyvalent or specific, is a potent remedy in the early phases of erysipelas.

Protein Therapy.—Foreign proteins and serums and autogenous serums are used in the treatment of diseases that are resistant to ordinary measures, notably psoriasis, chronic eczema, pemphigus, dermatitis herpetiformis, chronic urticaria, pustular acne, sycosis, and a few others. They must be combined with suitable local and general treatment to be effective in promoting a cure, and their action is not certain. The autogenous serum is prepared by withdrawing blood from the patient's median basilic vein. After clotting, it is centrifuged, and the serum is injected intravenously or intramuscularly under aseptic conditions, but the former is the more generally practised. From three to ten injections (20 to 30 cc.) are given at intervals of from three to six days. Horse serum has been used in place of human serum, and foreign proteids as turpentine in olive oil or in milk have been injected. Sterile milk is a common form of nonspecific protein. It must be boiled for at least fifteen minutes because of the danger of tetanus spores in it. Various vaccines, particularly stool vaccines and stock vaccines of typhoid bacillus, staphylococcus, streptococcus and B. coli, are used for nonspecific action in diseases which are recalcitrant to more direct measures. Whole blood injections (10 to 20 cc.) may be taken from one of the veins at the patient's elbow and injected intramuscularly into the buttock, a 20-gauge needle, $1\frac{1}{4}$ inches long, being used. These are forms of nonspecific protein therapy, the foundation for which is obscure.

Colloidal Therapy.—When a crystalloid is dissolved, it becomes dispersed throughout the solvent as particles, each of which consists of one molecule of the crystalloid. The individual chemical molecules are so minute that they can pass through porous membranes. A second type of solution called a colloidal solution was discovered by Graham. In it the dissolved substance exists in aggregates which are large compared with the molecular dimensions of the crystalloids. The properties of colloidal solutions are different from those of ordinary crystalloids, physically and physiologically. The metallic colloids are the most valuable therapeutically. When administered intravenously, they rapidly leave the blood stream and become stored in the liver and other organs where they produce a slow continuous, chiefly catalytic, action over a prolonged period. In addition, the injection is usually followed by a rise in temperature and a transient leukopenia and sometimes by increased metabolism, as shown by a larger excretion of nitrogen.

The place of colloidal therapy in dermatology is as yet undetermined because colloidal chemistry itself is still young. Colloidal silver has been used successfully in infections due to pyogenic cocci and in ringworm. Bigland and Sargeant employed colloidal iodine in actinomycosis. Intramuscular injections of colloidal manganese are a valuable supplementary remedy in the treatment of furunculosis, carbuncle, and pustular acne.

Diadermic Therapy.—Diadermic administration is a slow and indirect method of placing the medicaments into the circulation but has the advantages of an evenness and constancy superior to other routes. The amount of absorption, however, is variable, so that there is always a danger of toxic effects from excessive absorption of unresolved residues. The diadermic method relieves the alimentary tract from the irritations to which it is exposed when the medicament is given by the oral route. Absorption is favored by preliminary diaphoresis, heat and friction, and by cleansing with soap and hot water. The inunctions are applied in areas where the skin is thin, well supplied with lymphatics, and almost hairless, as on the flexures, the body surface being divided as described in the chapter on Syphilis (page 748).

The mercurial inunction is dirty and unpleasant. A "clean inunction" is equally efficacious and is given in the same manner except that the excess of ointment is removed by benzine immediately after the inunction. This inunction is, however, harder to give with accuracy although it is as effective as the dirty inunction if it is expertly done, but for general clinic practice the dirty inunction gives the most absorption and the best clinical results.

Anesthesia.—The anesthetics most commonly employed are ether and ethyl chloride, and injections of cocaine and novocaine. For certain operations, especially the removal of skin growths, treatment can be carried on only by the production of anesthesia. Whereas regional anesthesia does not take the place of general anesthesia, it is usually sufficient and has peculiar advantages for electrothermic work. Regional anesthesia is an art, as well as a science. Its skilful administration[1] is based upon a thorough knowledge of anatomy, technical experience, and individual deftness. Two different types of procedures are used—field block and nerve block. The former means the production of walls of anesthesia around the operative field. The solution is injected in a fan-shaped manner into and below the skin so as to affect all the nerves on their way to the operative area. Nerve block, on the other hand, is anesthesia produced by extraneural or paraneural injections in close proximity to the sensory nerves supplying the part. Local injections into the

[1] Labat, Gaston: Regional Anesthesia, Ed. 2, Phila., W. B. Saunders Co., 1928.

lesion are often helpful in supplementing the regional technic, but are objectionable in the treatment of malignant growths.

The technic of regional anesthesia requires that the patient should be placed in a comfortable state of mind, as well as of body. Apprehensive patients should be treated with special consideration. It is advisable to give all adults a small dose of morphine, preferably combined with scopolamine (morphine sulphate, 1/6 grain, and scopolamine hydrobromide, 1/300 grain) hypodermically one hour prior to operation. These drugs should be combined in the same solution and are given more to produce a feeling of well-being and to reduce the apperception than to influence the consciousness, which is maintained. The time required for the operation seems much longer to the patient than to the physician. Therefore, the patient should not be placed in an uncomfortable posture and be expected to maintain it, for such a strain taxes the cooperation and mental calm of the most docile person. A cold wet towel laid over the forehead and a few sips of cold water add to the patient's comfort.

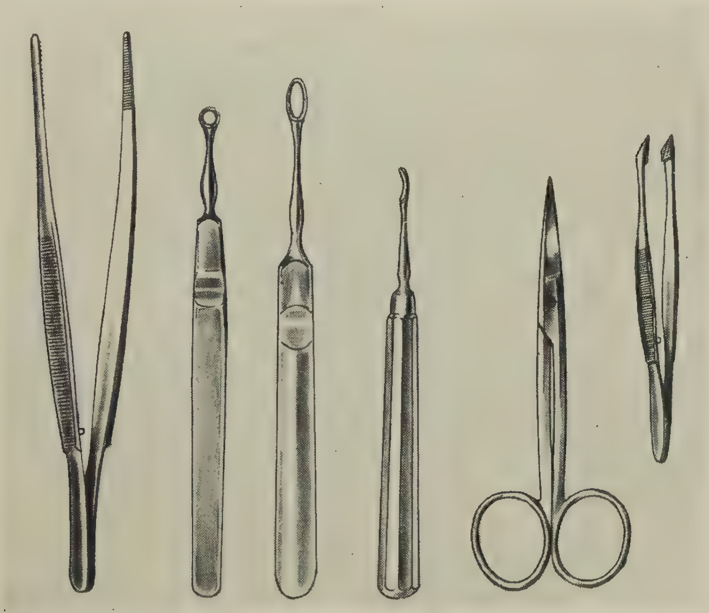

Fig. 46.—Dermatological instruments showing forceps, curets, small curved scissors, and epilation forceps.

Drugs Used Internally.—There is a series of drugs which, when administered internally, are believed to possess a selective action on skin diseases, but comparatively few are of real value. A drug may vary in its effects at different times in the same and in different individuals.

Adrenalin exerts a temporary palliative action in urticaria and inhibits or prevents the nitritoid reactions of arsphenamine, being given hypodermically in doses of 10 to 15 minims of a 1 : 1000 solution of adrenalin chloride.

Arsenic has certain dangers from an acute or chronic poisoning, leading to the production of nephritis or pigmentation, hyperkeratosis of the palms and soles, and carcinoma. It has been used too indiscriminately in dermatology in the past, for which reason we are at present seeing many cases of arsenical carcinoma usually in psoriatics or in those suffering from dermatitis herpetiformis.

Arsenic is valuable, but its action is not fully understood and at times is peculiar. It must never be administered at the eruptive stage of an affection or in acute inflammatory diseases as it may increase pruritus and aggravate the condition. It should never be prescribed for any prolonged period and should be discontinued at the first sign of gastro-intestinal irritation or puffiness under the eyes. In susceptible people small amounts may produce toxic symptoms, especially puffiness under the eyes or neuritis. Herpes zoster also is produced by the drug at times. In addition to its properties as a general tonic, arsenic when ingested affects the epithelial layers of the integument, stimulating their growth and, as stated, being conducive to malignancy. The hyperpigmentation caused by the drug is due to melanin.

Arsenic is used particularly in psoriasis, in lichen planus, chronic eczema, urticaria, pemphigus, pityriasis rubra pilaris, mycosis fungoides, pellagra, and Kaposi's sarcoma. Various preparations have proved beneficial in the treatment of syphilis, granuloma fungoides, and sarcoid. Small amounts are given for tonic effect when secondary anemia or nervous debility is concomitant with acne or any other skin disease.

The principal forms in which arsenic is used are Fowler's solution, Donovan's solution, Asiatic pill, cacodylate of sodium, arsenic trioxide, and arsenate of iron. Arsenic trioxide (arsenous acid) is as good as any, and is given in pills or in solutions in doses of 1/100 to 1/30 grain (0.0006 to 0.002 Gm.).

Antimony and potassium tartrate, U. S. P. (tartar emetic) is used intravenously in the treatment of certain protozoan infections, especially in granuloma inguinale and leishmaniasis. Intravenously, the drug is given in 1 per cent physiologic solution of sodium chloride, the initial dose being 0.01 Gm. The intravenous injections are usually given on alternate days for two or three weeks in doses ranging from this amount up to 0.05 Gm. The total dosage should not be greater than 0.5 Gm. in any uninterrupted course of treatment.

Arsphenamine is used in the treatment of syphilis, yaws, Vincent's angina, lichen planus, and tuberculides. It is a specific remedy for syphilis in all stages, being most efficient in the recent infections. It must be cautiously employed according to the technic described in detail in the chapter on Syphilis (page 734). Its use by any one who has not mastered the proper technic of preparation and administration is dangerous.

Benacol is a benzoic salt of anesthesin, which is given in solution in sweet almond oil subcutaneously for the relief of localized itching. The drug is a new one, is apparently innocuous and is extremely effective in the treatment of pruritus ani, neurodermatitis, and other localized varieties of intense pruritus. The technic is given in the chapter on Pruritus (page 367).

Bismuth.—See Syphilis (page 743).

The *bromides*, chiefly those of sodium, potassium, strontium, and ammonium, are given as mild sedatives but their use is fraught with the hazard of bromism. The intravenous use of solutions of bromides, especially strontium bromide, is apparently more beneficial than oral administration in some cases of eczema and dermatitis herpetiformis.

The administration of *calcium lactate* has been found to show benefit in disorders of the skin in which there is diminished coagulability of the blood or decreased blood calcium as in some cases of erythema multiforme, urticaria, eczema, purpura, pernio and angioneurotic edema. Its absorption is probably increased by the concomitant use of parathyroid substance and ultraviolet light. Colloidal calcium may be substituted for the lactate, or the calcium may be given as the glycerophosphate.

Chaulmoogra oil is used in the treatment of leprosy, the active principles being chiefly chaulmoogric and hydnocarpic acids, which are destructive to the bacillus that causes the disease. The oil is replaced in therapeutics by chaulmestrol (ethyl chaulmoograte, U. S. P.), which has the advantage of greater uniformity and better toleration. Chaulmestrol is given by mouth or by intramuscular injection, the dose being 1 cc. (15 minims). Sodium gynocardate is an effective remedy, being employed either intravenously or intramuscularly in graduated doses.

Enesol is a foreign drug containing arsenic and mercury. It is mentioned because of its superior effects upon lichen planus, in which disease it is given intramuscularly.

Gold sodium thiosulphate is used in solution intravenously in lupus erythematosus and other varieties of cutaneous tuberculosis, and has been beneficial in some cases of leprosy, psoriasis, and lichen nitidus.

The *iodides* are without doubt valuable therapeutic remedies for syphilis in its late manifestations, for actinomycosis, blastomycosis, and sporotrichosis. They cause absorption of granulomatous infiltrations. Idiosyncrasy toward the iodides is common and may be expressed by neuritis, urticaria, papular or pustular acneiform eruptions, or fungating lesions. The iodide of potassium is the one most commonly used. Sodium iodide and other preparations such as iodipin and collosol iodine are less powerful substitutes but supposedly less depressant. Orally, potassium iodide is given in simple solution, well diluted, in doses of 30 grains increased gradually up to the limit of tolerance. The saturated solution of potassium iodide (N. F.) contains 100 per cent of potassium iodide and is given in doses of 0.3 cc. or 5 minims t. i. d., increased as tolerated.

Mercurochrome-220 soluble is used intravenously with benefit in some cases of erysipelas, pemphigus, sycosis vulgaris, chancroid, cellulitis, and leprosy. Severe and even fatal systemic reactions may occur, so caution is advised.

Mercury preparations are effective in the treatment of syphilis, particularly in the late stages of the disease. The drug is usually given by intramuscular injection or by inunction. The various preparations and dosages are described in the chapter on Syphilis (page 746). This remedy is also of value in lichen planus and in juvenile flat warts.

Neoarsphenamine.—See Syphilis.

Pilocarpine is employed in instances in which an increase of sweat secretion is desired. Hypodermic injections of the drug have been given with benefit in parapsoriasis. Without sufficient proof it is accredited with a favorable influence upon the growth of hair.

Benefit has been claimed for *quinine* in lupus erythematosus, pemphigus, pruritus, dermatitis herpetiformis, dermatitis exfoliativa, erythema nodosum, erythema multiforme, herpes zoster, and eczema. Either the dihydrochloride or sulphate is used in moderate doses, usually 2 grains t. i. d.; or in severe conditions solutions are given intravenously.

Silver Arsphenamine.—See Syphilis (page 740).

Sulpharsphenamine.—See Syphilis (page 740) and Verruca (page 872).

Sulphur is taken internally as a mild cathartic. After ingestion it is probably eliminated through the skin and has a germicidal effect as well as a stimulating action on the epithelium. Solutions of sodium thiosulphate are used extensively both by mouth and intravenously for the treatment of arsphenamine dermatitis, and other skin conditions related to metallic intoxication.

Thallium acetate is given by mouth to produce epilation in diseases of the hairy parts, chiefly in tinea tonsurans.

Tryparsamide.—See Syphilis (page 750).

Yeast is reputed to be beneficial in furunculosis, acne vulgaris, and in constipation associated with other skin diseases. Occasionally it probably has some therapeutic action, but its benefits have been so exaggerated for commercial purposes that these are insignificant compared to its reputation.

LOCAL TREATMENT

Treatment by various mechanical and electrical agents is considered in the respective chapters on these subjects and in other parts of the book.

External medicinal treatment is of value for cutaneous diseases both for its curative effect and for the purpose of immediate relief of itching, burning, and other annoying subjective symptoms. As individuals vary as to the sensitiveness of the skin, care should be exercised in the proper selection of local medicaments. The kind of external treatment is governed by the nature of the pathologic process.

Soothing and **protective applications** are known as **emollients.** Protectives are used to shield normal or inflamed surfaces from local irritation due to dirt, rubbing, injury from sunburn, exposure to wind, *et cetera.* Bland powders and lotions are sometimes preferable to thick pastes and ointments. Talcum, boric acid, calomel, zinc oxide, magnesium oxide, bismuth subcarbonate, and starch are commonly employed as dusting powders. Cooling agents are occasionally indicated; they consist mostly of water and alcohol, and are used on inflamed parts. The skin is cooled by the evaporation of the aqueous or alcoholic lotion, or by cold creams. Alcoholic lotions should not be applied to abraded skin.

Antipruritics alleviate irritation and itching. Those most extensively employed are menthol, phenol, resorcin, oil of cade, and salicylic acid. Alcohol and a solution of baking soda are sometimes serviceable. Antipruritics act either on the sensory nerve endings, as carbolic acid; or by causing a cooling sensation in place of the itching, as menthol. Liquor carbonis detergens, a solution of coal tar, alcohol and soap bark, is a common antipruritic remedy, being used chiefly in lotions.

Astringents are employed on cutaneous inflammations accompanied by edema and exudation. Those most generally applied are lotions containing lead, alum, zinc sulphate, silver nitrate, and formalin; or powders; or powders suspended in lotions, particularly zinc oxide, bismuth salts, and calamine. Their action is twofold, contracting the blood capillaries, and thus controlling exudation, and coagulating the albumin in the tissue fluids.

Analgesics may be required to alleviate irritation and pain. Carbolic acid in a weak solution is analgesic, as is orthoform. In inflammatory affections of the skin, the application of most analgesics produces subsequent irritation.

Stimulants are occasionally necessary in chronic inflammations of the skin. They bring an increased supply of blood to the area and produce a recession of the pathologic process by absorption. Chrysarobin, oil of cade, balsam of Peru, sulphur, iodine, and the salts of mercury are in common usage.

Antiseptics and **caustics** are applied in various forms. Cutaneous infections, being frequently located below the surface of the skin in the corium and hair follicles, are not easily controlled by antiseptics. The mercury compounds (oxide of mercury, bichloride of mercury, the oleate, ammoniated mercury), boric acid, salicylic acid, carbolic acid, resorcin, potassium permanganate, sulphur, tar, and iodine are employed for this purpose, the ointments being preferred, although lotions and wet dressings have their use in extensive and superficial involvement. Caustics, which produce local tissue destruction, are occasionally applied to horny thickenings as callosities and warts, and to check the spreading of granulation tissue, lupus nodules, and new growths. Some caustics are mild in action (as salicylic, acetic, chromic and lactic acids, zinc chloride, copper sulphate, resorcin); others more powerful (as silver nitrate, trichloracetic and glacial acetic acids, pyrogallol, caustic potash, nitrate of mercury, arsenic, phenol, and sodium ethylate). The galvanocautery, the actual cautery and solid carbon dioxide are also employed for this purpose.

The **detergents** are used to remove dirt, scales, discharges, and crusts from the skin. Water, or soap and water are generally employed except where inflammation is present, when pastes of boric acid and starch, oils, and creams should be applied.

Keratolytics dissolve the keratin of the horny cells, thus reducing the thickenings of the horny layer. Salicylic acid, resorcin and alkalies, especially in soaps, are thus used mainly to remove scales, callus, and corns.

Parasiticides are applied as destructive agents to parts invaded by animal and vegetable parasites. In lotions, pastes, or ointments the following drugs are used: Sulphur, chrysarobin, balsam of Peru, the salts of mercury, betanaphthol, benzoic acid, sodium hyposulphite, sulphide of calcium and of potassium, iodine, thymol, salicylic acid.

Drugs Used Externally.—Only the most widely employed external medicaments in the treatment of diseases of the skin are mentioned.

Alcohol is used as an antiseptic and as a soothing solution with cooling effect. It is a solvent for grease and dirt, a dehydrating agent, and is used on the surface of the skin in preparation for electrolysis. As a medium for other drugs it is employed only on unbroken skin.

Adrenalin solution (1 : 1000) has value in stopping bleeding from the capillaries.

Alum is an astringent which is occasionally incorporated in face powders for rosacea, or in dusting powders for the feet.

Solution of *aluminum acetate*, N. F. (Burow's solution), contains 5 per cent neutral aluminum acetate and is widely used as an astringent, being diluted with about fifteen parts of water.

Arsenic is a strong caustic, which is occasionally used in destroying neoplasms, mostly in a paste of arsenous acid.

Balsam of Peru acts as a stimulant and a parasiticide. It is used externally in the form of ointments or alcoholic solutions in the treatment of scabies, and as a stimulant to indolent ulcerations.

Benzoic acid is a parasiticide and a keratolytic.

Beta-naphthol, U. S. P., is an antiseptic and antipruritic similar to phenol and is used externally as ½ to 5 per cent ointment. It is sometimes very irritating due to individual hypersensitiveness.

Boric acid is commonly used as a mild though soothing astringent and antiseptic, especially in wet dressings. It is also serviceable in the form of powders and ointments.

Prepared calamine is a pink powder which is insoluble in water; it consists of zinc oxide containing small amounts of ferric oxide and silica. It is a protective, similar to zinc oxide, over which it has no therapeutic advantage. It has, however, a particularly wide use in cutaneous affections, being the chief ingredient of calamine lotion. Calamine liniment is an emulsion of prepared calamine and zinc oxide, each 8 per cent in olive oil with calcium hydroxide. Calamine ointment contains 17 per cent of prepared calamine.

Camphor in the form of camphor water, U. S. P., which is a saturated solution, or in 1 per cent alcoholic solution is employed as a mild counterirritant and antipruritic, usually being combined with other drugs such as phenol and menthol.

Capsicum is a rubefacient. The oleoresin and tincture are used to produce hyperemia of the scalp in various forms of alopecia.

Carbolic acid finds an extensive use as an antiseptic, antipruritic, analgesic and, in a strong solution, as a caustic. It may be employed up to 10 per cent in lotions and ointments as a parasiticide in the treatment of pediculosis and ringworm, in 1 per cent strength as a soothing and antipruritic agent, and in 2 per cent as an anesthetic in furunculosis.

Carbon tetrachloride in 5 per cent mixture with alcohol (50 per cent) is used as a cleansing and bleaching agent in the treatment of seborrhea and lentigo.

Chloroform is used as a counterirritant, anodyne, and antipruritic in ointments in ¼ per cent strength upward.

Chrysarobin is regarded as an antiparasitic and reducing agent. In pastes and ointments it is employed in varying strengths. Chrysarobin ointment, U. S. P., is 6 per cent strength in hydrous wool fat. Chrysarobin is soluble in chloroform and with or without the addition of pyroxylin is used in the form of a paint in strengths up to 20 per cent. It is used chiefly in chronic psoriasis and in affections of the skin due to fungi. If employed extensively or over a protracted period it is likely to irritate the skin and its absorption may cause symptoms of toxic disturbance. Products substituted for chrysarobin are anthrarobin and neochrysarobin, which have certain advantages.

Formalin (commercial name of a solution of formaldehyde, U. S. P.) is a 37 per cent solution of formaldehyde with methyl alcohol and water. It is used upon the skin for its drying and bleaching effects, mostly in hyperidrosis and chloasma. It is a powerful germicide and is used in a 1 per cent solution upon the mucous membranes in the treatment of thrush. A 10 per cent solution of formalin is a standard medium of fixation for pathologic specimens.

A 2 per cent aqueous solution of *gentian violet* has a selective bactericidal action, and is used as a local antiseptic in folliculitis, dermatophytosis, and various other superficial infections.

Glycerin is frequently employed in lotions to relieve excessive dryness of the skin and to suspend powders. It has an irritating action on the skin in some instances and should then be avoided. When used in lotions it leaves a sticky feeling, which is unpleasant.

Although *ichthyol* has been omitted from the U. S. Pharmacopoeia, it is nevertheless a popular dermatological remedy and is credited with astringent and mildly stimulating properties. It is used in ointments and applied to allay inflammation and to relieve congestion especially in the early stages of furuncle, in erysipelas and upon chilblains. It is commonly employed in a strength of 10 per cent mixed with basilicon ointment; in lotions in strengths of 5 to 30 per cent it acts as a mild soothing astringent in dermatitis venenata.

The tincture of *iodine* (a 7 per cent alcoholic solution, with 5 per cent potassium iodide) and compound solution (Lugol's), containing 5 per cent of iodine and 10 per cent of potassium iodide in water, are used externally as local irritants and antiseptics, and internally for its effects upon the thyroid gland, and in certain fungus diseases. The local irritant action can be graduated by a repetition of the applications. Iodine is a strong parasiticide, being employed in diseases due to fungi. For ringworm of the scalp a popular prescription is 20 per cent iodine in goose grease, which is rubbed into the scalp morning and night. Iodine ointment, U. S. P., containing 4 per cent each of iodine and potassium iodide in glycerin and wool fat, is used for similar purposes and also as a counterirritant on inflamed corns and bunions.

Juglans, N. F., is used in the form of a fluidextract as a paint to tint depigmented spots.

Menthol is employed locally as a counterirritant and analgesic. It is incorporated into ointments and creams, and into alcoholic solutions, being only slightly soluble in water.

Mercury and mercurial compounds have an especially wide use in cutaneous diseases, being antiseptic and stimulating. The salts most generally employed are ammoniated mercury, calomel, red and yellow oxides, mercurial oleate, the nitrate, and corrosive sublimate; the latter is a valuable parasiticide in an ointment or lotion. Unguentum hydrargyri fortius is used in inunctions in syphilis.

Oil of cade, a distillation product, is an effective stimulant and has wide use, particularly in eczema.

Potassium permanganate is an antiseptic, deodorant and astringent, as well as an antiparasitic. In the treatment of lupus vulgaris it may be painted upon the skin, like iodine, or be applied as a powder. It is used in baths in solution of 1 : 500 as an antiseptic in cases of dermatitis due to pyogenic organisms, or in dermatophytosis, and as a wash in chronic ulcers and in hyperidrosis.

Pyrogallol in weak strengths has an antiseptic and irritant action, while in stronger preparations it possesses keratolytic and caustic power. It is used in reducing horny thickenings as on the palms and soles and in the form of a 10 per cent ointment has a caustic effect on the nodules of lupus vulgaris. In psoriasis of the inveterate type, 4 to 6 per cent pyrogallol in ointment is effective, but must not be used upon the head, for it is irritating. Internally it is highly toxic.

Resorcinol is extensively employed in cutaneous diseases. Its action is antipruritic, antiseptic, and astringent, and in a concentrated form is keratolytic. In the treatment of acne and chronic scaly affections it is used to produce exfoliation of the epidermis. It is a common ingredient of hair tonics, but it should not be used on individuals with gray or blonde hair, because it will change the color. Resorcin is frequently irritating, and idiosyncrasy to it is not uncommon. The compound resorcinol ointment (N. F.) contains 6 per cent each of resorcinol, zinc oxide, bismuth subnitrate, and rectified oil of birch tar in yellow wax, petrolatum, glycerin, and wool fat. It is a mildly antiseptic, keratolytic, and stimulating ointment.

Salicylic acid is largely used in lotions, ointments, and pastes as an antiseptic and keratolytic. It is freely soluble in alcohol (1 to 2.7) and in ether, and slightly soluble in water (1 to 460). Salicylic acid (10 per cent) and flexible collodion colored with fluid extract of cannabis are an effective remedy for softening corns and horny thickenings. Salicylic acid soap plaster, 5 to 10 per cent, is used for similar purposes, as well as upon boils as a drawing salve. For extensive hyperkeratotic areas, salicylic acid adhesive plaster, 10 to 20 per cent, is applied. Compound powder of talc, N. F., is used for hyperidrosis and contains salicylic acid (3 per cent), boric acid (10 per cent), and talc. Ten per cent salicylic acid in unguentum plumbi oleatis (formerly known as diachylon ointment) is a strongly keratolytic ointment. Whitfield's ointment for dermatophytosis contains 6 per cent salicylic acid and 12 per cent benzoic acid. In the discoid type of lupus erythematosus Satenstein recommends 5 to 20 per cent salicylic acid, and 2 per cent camphor in an alcoholic solution of bichloride of mercury, 1 : 500, to be used as a paint.

Silver nitrate is used externally as a caustic, antiseptic, and germicide, usually in the form of lunar caustic, which is a hard white pencil of silver nitrate toughened by the addition of a small proportion of silver chloride. The concentrations of solutions for local use vary up to 10 per cent according to the sensitiveness of the surface and the degree of action desired.

Sodium perborate is an antiseptic and deodorant, being applied as a dusting powder in the treatment of Vincent's angina.

Sulphur is an antiseptic, antiparasitic, and stimulant. It is most soothing in its precipitated form, in lotion, or ointment. In strong preparations it is likely to cause irritation. The affections in which it is most commonly used are seborrhea, acne, and parasitic conditions as scabies and ringworm. The principal preparations used are lotio alba, which is described in the chapter on Acne Vulgaris (page 501); sulphur praecipitatum and sulphur lotum or sulphur sublimatum, which are incorporated into ointments or dusting powders. A favorite combination is Wilkinson's ointment, the formula of which is given under Scabies (page 794). Colloidal sulphur is on the market and may be used for sulphur baths or applied externally, being especially suitable for use on the scalp because it is easily removed by washing. A solution of sodium hyposulphite is applied externally in the form of a lotion for ringworm and other parasitic diseases.

Tar is a thick brown to black viscous liquid produced by the destructive distillation of wood, coal, or peat. It contains a great variety of compounds, among which are pyroligneous acid, toluene, xylene, pseudocumene, cresol, phenol, guaiacol, creosol, paraffin, naphthalene, pyrocatechin, *et cetera*. Oil of cade, U. S. P., is an empyreumatic oil produced by the dry distillation of juniper wood and is used in the form of a 1 to 10 per cent ointment as a stimulant in chronic inflammatory dermatoses. Pix carbonis, or coal tar, N. F., is a black semisolid substance with a characteristic naphthalene-like odor, obtained by the destructive distillation of coal. Crude coal tar is used in 5 to 10 per cent strength in zinc oxide ointment in the treatment of infantile eczema. Coal tar solution, N. F. (liquor picis carbonis detergens), is a 20 per cent solution of coal tar, quillaja, and alcohol. It is an antipruritic and mild stimulant when added to lotions and ointments in strengths of 1 to 4 per cent. The full strength solution is useful as a local application in psoriasis of the scalp on account of its stimulating properties combined with its cleanness. Pine tar, U. S. P., is obtained by the destructive distillation of pine wood. It is a semiliquid, viscid substance, which is slightly soluble in water and miscible with alcohol. It is used in ointments at first from 2 to 4 per cent and later in higher strength. Tar ointment, U. S. P., contains pine tar, 50 per cent, yellow wax and petrolatum, whereas compound tar ointment, N. F., contains rectified oil of tar (4 per cent), zinc oxide (3 per cent) and tincture of benzoin in yellow wax, lard and cotton seed oil. Rectified oil of birch tar, N. F. (oleum betulae empyreumaticum rectificatum, formerly oleum rusci rectificatum), is obtained by the dry distillation of the bark and wood of white birch, and is used in ointments of 2 to 10 per cent strength as a stimulant and antiseptic, chiefly in the treatment of psoriasis and eczema, its action being similar to that of tar. Naftalan is an unofficial remedy made by the fractional distillation of naphthalene obtained from the Caucasian lakes.

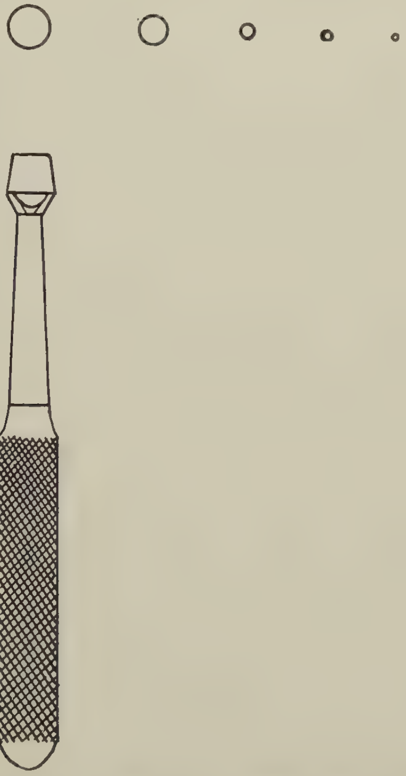

Fig. 47.—Keyes' skin punch. Circles above illustrate actual sizes customarily used. The larger sizes are suitable for taking biopsies, and the smaller ones for the removal of powder stains.

Thymol is an antiseptic, antipruritic, and fungicide. It is used principally in the treatment of dermatophytosis, being applied in alcoholic solution or in an ointment (1 per cent).

Trichloracetic acid is an effective caustic.

Zinc chloride, U. S. P., is an antiseptic, astringent, and escharotic, and is used in solutions of 5 per cent strength for the treatment of hyperidrosis and dermatophytosis. Solution of zinc chloride, U. S. P., is about 50 per cent strength and is employed as an escharotic in the treatment of cancer.

Zinc oxide, U. S. P., is widely used either alone or in combination with other substances as a protective and local sedative in the form of dusting powders, ointments, and lotions. Ointment of zinc oxide, U. S. P., contains 20 per cent zinc oxide in paraffin and white petrolatum. Pasta zinci, N. F. (Lassar), contains zinc oxide (24 per cent), salicylic acid (2 per cent), starch, and petrolatum. Both the firm and soft varieties of zinc glycerogelatin, N. F., contain zinc oxide, 10 per cent in glycerin, water, and glycerinated gelatin.

Form of Application.—There is a variety of forms in which medicaments may be applied to the skin. These will be briefly considered.

Baths, aside from cleansing purposes owing to their macerating action, have various effects according to their temperature and contents. In an acute inflammation of the skin, especially eczema, the use of water must be limited as it tends to aggravate the affection. A cold shower or plunge serves as a stimulant and tonic, but as excessive use of them is depressing, they are not advisable for individuals of weak constitution or poor circulation.

Warm to hot baths have a sedative effect. When the skin is inflamed, drying should be done by patting and blotting up the water with a towel and not by rubbing. Continuous baths at body temperature are sometimes prescribed for burns. Steam and hot-air baths are only occasionally used in cutaneous diseases, as they are followed by depression. Whatever benefit is derived from natural spring-water baths arises largely from the change of environment, diet and by exercise rather than from direct medicinal properties. Wet packs may be employed in the place of hot baths for the removal of scales and crusts.

Baths containing linit, starch, gelatin, oatmeal or bran are soothing, relieving the irritation and erythema in some of the acute and hyperemic affections, and in such chronic diseases as dermatitis exfoliativa when of the acute type. For detergent purposes in some chronic sluggish, scaly dermatoses, such as in most cases of psoriasis and in icththyosis, alkaline baths are recommended. Sodium bicarbonate, sodium borate, potassium carbonate, or ammonium chloride, from 2 to 6 ounces, is added to an average tub of 30 gallons of water. Baths containing these substances and menthol in alcohol (ʒii of a 25 per cent solution) allay itching in such affections as urticaria and prurigo. The addition of antiseptics is sometimes advantageous, boric acid being used in cases of pyogenic infections involving large surfaces. Solution of sulphurated lime (Vleminckx's solution), dissolved in a tub of water, has some use in seborrheic dermatitis, psoriasis, and in scabies. When the medicament used reacts on metal, an earthenware bath tub is necessary. Special kinds of baths are not as widely used in this country as abroad for the treatment of skin diseases.

The following table is used by me to instruct patients concerning the type of bath desired, by crossing out the undesirable features or checking the advisable ones:

Bath:
Frequency..........times daily.
Time of day..........A. M..........P. M.
Kind, sponge to..........only, tonic tub with gelatin, starch, linit, bath salts, sea salt, sodium bicarbonate..........meal, bran, ammonia, carbolic acid, Burow's solution, bichloride of mercury, special formula.
Amount to put in each tub of water..........
Shower (wear rubber swimming cap in shower).
Temperature..........degrees reduced to..........gradually.
Duration.
Followed by: Brisk rub-down with coarse Turkish towel; gentle patting, with soft hand towel; alcohol rub; special medication; after-bath lotion; ointment; powder.
Soap: Any good bath soap.
Castile soap.
Superfatted lanolin soap.
Tar soap, resorcin soap, iodine soap.
Physicians' and surgeons' soap.
Hand Sapolio.
Laundry soap.
Soap of special formula.
Avoid soap. Avoid water.
Cleanse skin with olive oil, linseed oil, mineral oil or cleansing cream on cotton without undue rubbing.

Soap is used chiefly as a detergent and in solution as a vehicle for liniments. Soap, U. S. P., is prepared from olive oil and sodium hydroxide (olive oil castile soap). Soft soap, U. S. P., is prepared from linseed oil and potassium and sodium hydroxides. Emplastrum saponis is made from 10 per cent soap and 90 per cent lead plaster. Tincture of green soap is soft soap (65 per cent), and oil of lavender in alcohol (30 per cent). The compound tincture of green soap contains 15 per cent soft soap, 2 per cent oil of cade, and 75 per cent alcohol.

Soap, though often required for cleansing purposes, when used excessively may be harmful. In acute eczema or dermatoses its use is prohibited. Soap softens the keratin in the horny cells and removes the fat and, if employed indiscriminately, it reduces the protective power of the stratum corneum.

In the process of washing with soap a certain amount of alkali is liberated and combines with the grease, undergoing saponification, which cleanses the skin. Mild (hard) soaps are usually used for toilet purposes and are best when nearly neutral, excessive free alkali being irritating. A superfatted soap offends some skins less and is advisable with hard water to produce a good lather.

Strong (soft) soaps known as potash soaps are used mostly to soften scales and crusts, green soap (sapo viridis) being the one commonly employed.

Various drugs, as sulphur, naphthol, carbolic acid, tar, resorcin, salicylic acid, camphor, and balsam of Peru, are incorporated in soaps. The medicament being in a diluted form its action in such a combination has little value and at best is temporary. The main usefulness is probably in a shampoo for certain conditions of the scalp.

Powders are soothing and cooling to the skin by absorbing some moisture, and are also protective. Among those in common use are zinc oxide, talcum, zinc stearate, zinc oleate, starch, magnesium carbonate, rice, lycopodium, kaolin, bismuth subnitrate, and prepared chalk. Those used for a medicinal effect contain such antiseptics as boric acid, calomel and salicylic acid, and are prescribed in erythematous eczema, erythema intertrigo, hyperidrosis, and other dermatoses. To have any value a dusting powder must be smooth and fine.

Lotions have a wide use in dermatology, being more pleasant to employ than ointments and more effective as medicaments than powders. The basis is usually water—sometimes rose water and lime water—or alcohol, the latter increasing the drying and cooling effect. In small amounts, glycerin is occasionally added to diminish or avoid dryness of the skin, which often follows the application of a lotion. Boric acid, aluminum acetate, calamine, menthol, phenol, and camphor are common ingredients. Besides soothing, antipruritic, and antiseptic lotions, there are astringent lotions containing tannin, alum, and zinc sulphate, and stimulating ones containing tar and sulphur. The application of lotions is commonly made in acute inflammatory affections, in acne, various forms of eczema, pruritus, and erythema intertrigo. Specific lotions are given elsewhere.

Wet dressings or *compresses* are employed to relieve irritation or to render medication continuous, to dissolve crusts and scales or for antiseptic effect. The cotton or gauze may be repeatedly saturated with the solution, or it may be frequently poured on the compress in place. Oiled silk is placed over the dressing to prevent evaporation.

Oils in preparations have the advantage of increasing the penetration of the medicament into the skin. In certain dry, scaly conditions the application of oily and greasy preparations offsets the deficiency in epidermal fat. For the removal of scales and crusts dressings soaked in oil, especially olive oil, may well be used in the place of lotions. Oils are also applied for lubricating and protective purposes. In addition to olive oil, others frequently employed are almond oil, liquid petrolatum, and linseed oil. Other ingredients as lime water, calamine, and zinc oxide are added to form emulsions or liniments according to the effect desired.

Ointments, *pastes*, and *cerates* are important dermatologic remedies because of their softening, soothing, and protective qualities, due to fatty constituents similar to sebum. Fatty vehicles form the best means of gaining penetration into or absorption by the skin.

Ointments are fatty substances of the consistency of lard, which are applied by inunction and gradually melt at the body temperature. *Pastes* are doughlike preparations composed of ointments containing large amounts of powder or of nonfatty substances such as glycerin with gelatin or starch. They have a slightly drying and absorptive action. A *cerate* resembles an ointment, but has a firm consistency and a higher melting point (about 104 F.). They have a soothing and protective action on acutely inflamed or raw surfaces, and prevent adherence of gauze dressings to the parts.

Ointments, pastes, and cerates should not be applied to exudative lesions, for they produce a retention of the exudate, which favors secondary infection. Pastes, on account of their slightly absorptive action, may be used when the exudation is slight, but when a paste dressing is elevated by an accumulation of exudate, a different type of dressing should be applied.

Detailed instructions must be given concerning the quantity and frequency of application and whether the preparation is to be covered with some kind of dressing, to keep it in place. Talcum powder or face powder may suffice for pastes; gauze for cerates; and some nonabsorbent material such as gutta percha tissue or oiled silk for ointments. A rubber swimming cap may be used on the scalp, but should be so large as not to provoke a headache. Such a cap intensifies the action of the ointment, due to the sweating it causes. For the hands and arms, feet and legs, white stockings are serviceable. The axillae may be dressed by pads of gauze pinned to the underwear like dress shields. For the penis or scrotum a Japanese suspensory, into which the part is placed, is used; and for the perineum or gluteal crease a pad is applied with a T-bandage, the buttocks being pulled apart by adhesive plaster straps stretching from each iliac crest.

The more common bases of ointments are petrolatum and wool fat. Petrolatum is the best vehicle when surface action is desired. Lanolin, without much reason, is reputed to have superior penetrating qualities. The principal disadvantage of petrolatum is its inability to absorb water or alcohol, so that lanolin or wax mixtures are necessary when fluid is incorporated. In hot weather these substances also have a stiffer consistency than petrolatum. Consequently, mixtures of petrolatum and lanolin are popular as vehicles. Anhydrous lanolin is used only when a large amount of fluid is to be incorporated, as otherwise it is unduly tenacious. The addition of white wax or paraffin, about 30 per cent, gives the consistency of a cerate. Petrolatum, usually stiffened by the addition of 5 per cent yellow wax, 20 per cent lanolin, or 15 per cent paraffin is the base of most of the official ointments.

Ointments are soothing, protective, antiseptic, stimulating, *et cetera*, according to the active medicaments and the proportions incorporated in them. Soothing and protective ointments consisting chiefly of zinc oxide, zinc oleate, prepared calamine, bismuth subnitrate, and diachylon, are employed in acutely inflamed dermatoses. Ointment of lead oleate (diachylon ointment) is a tenacious preparation composed of lead oleate plaster, white petrolatum, and 1 per cent oil of lavender. An antiseptic property is obtained by the addition of salicylic acid or boric acid. Stimulating ointments contain, in addition to the bases, such constituents as sulphur, tar and its derivatives, chrysarobin, resorcin, and mercurial compounds.

Ointment of rose water (cold cream) is a greasy preparation, containing 20 per cent stronger rose water, which by its evaporation produces a cooling effect. It is particularly beneficial in acute inflammations. In addition to the rose water, the ingredients are expressed almond oil, white wax, and spermaceti, with 0.5 per cent sodium borate, which must be borne in mind as a possible cause of incompatibility. Cold cream has a tendency to become rancid and to separate on standing, for which reason most commercial cold creams contain liquid petrolatum, white petrolatum, and white wax; and the substitution of glycerin and oil of rose for rose water, thereby lessens the cooling effects. "Greaseless cold creams" are not cold creams, but mild soaps made from stearin and sodium carbonate, possessing chiefly a detergent action on the skin.

Pastes are prepared by the addition of a bland absorbent powder to ointment bases. They have a stiffer consistence and greater adhesiveness than ointments, and are especially of value in eczematous affections of a subacute type. Owing to their porosity and power to absorb secretions they may be used on edematous areas. They can be removed by olive oil. They are not suitable for hairy surfaces, tending to mat hairs together. For facial use pastes, as well as ointments, may be rendered the tint of the skin by appropriate insoluble pigments.

The bases and active components are similar to those used in ointments, and the pastes acquire their properties as protectives, antiseptics, *et cetera*, accordingly. Zinc oxide, talcum, starch, bismuth, magnesium carbonate, and kaolin are the absorbent powders most commonly incorporated. Lassar's paste consisting of 24 per cent zinc oxide, starch and petrolatum—with or without 2 per cent salicylic acid—is popular for acute dermatitis.

Oil, cold cream, vaselin, and gasoline are used to remove residues of salves. Irritation may be caused by too frequent or too energetic removal. Generally cleansing with soap and water is deleterious in acutely inflamed conditions of the skin.

Oil pastes may be substituted for unguent pastes when the skin is very irritated. Unna's soft zinc paste (N. F.), composed of equal parts of zinc oxide, calcium carbonate, linseed oil, and lime water, or an oil paste composed of equal parts of zinc oxide and olive oil is soothing to the most irritated conditions.

Nonfatty pastes are more cooling than those of fatty consistency and are, therefore, better tolerated in acute dermatoses. Starch paste is prepared by rubbing laundry starch into a jelly by constantly stirring and adding small amounts of boiling water. It is prevented from drying too rapidly by the addition of 10 per cent glycerin. It is valuable for the removal of crusts from irritated skin, this action being enhanced by the addition of boric acid, 1 teaspoonful to the pint. Pick's paste is a drying paste composed of 5 per cent tragacanth, and 2 per cent glycerin in water, and is used upon infantile eczema.

Poultices, or *cataplasms*, are warm or hot pastelike compresses applied to give heat and moisture to a part, to allay inflammation, and to remove crusts. They retain their heat longer than hot fomentations. A flaxseed poultice is prepared as one cooks breakfast cereal. The flaxseed is stirred in boiling water over a slow fire to make the consistency of a thick paste and this is spread on the center of a piece of muslin up to an inch or two of the edges, which are then folded over, and the top is covered with another piece of muslin. The proper temperature is that easily tolerated by the back of the hand. Heat is retained longer by covering the poultice with waterproof material or cotton, the whole being retained by a bandage. When the warmth has disappeared, another poultice should be in readiness for application. Used poultices may be reheated in a double boiler.

Fixed dressings are employed in cutaneous affections both for protection against atmospheric irritation and against friction, and variously medicated they exert some action on the diseased surface. The glycerogelatin containing a melted mixture of glycerin, gelatin, zinc oxide and water is painted upon the skin. On cooling, such a dressing forms a pliant, fixed covering which absorbs moisture, and does not prevent evaporation. As the glycerogelatins are not irritating, they may be applied to inflamed areas, being commonly used in the treatment of varicose eczema and ulcer.

Salve pencils have a very limited field of usefulness, namely, application to small spots. They are cylindrical sticks consisting of wax, a gummy substance, or tragacanth, and lanolin incorporated with different medicaments. Salicylic acid pencils (N. F.) may be applied to patches of psoriasis and eczema. The silver nitrate pencil (lunar caustic) is employed on fissures, ulcers, and exuberant granulations.

Paints are usually strong liquids which are painted upon the diseased areas to produce hyperemia, counterirritation, keratolysis, analgesia, relief of itching, asepsis, or stimulation. Alcohol, glycerin, water, chloroform, or ether are common vehicles. Tincture of iodine and balsam of Peru are examples of paints. Perhaps the simplest is the compound tincture of benzoin. Alcohol, acetone or chloroform, in which such medicaments as tar, chrysarobin, pyrogallol, *et cetera*, have been dissolved, when painted upon the skin evaporates with a pleasant sensation of coolness.

Varnishes are protective medicated coatings, impervious to water. Flexible and plain collodion and liquid gutta-percha may be used as vehicles of medicaments. Those which contain chrysarobin or salicylic acid are chiefly employed in psoriasis, lupus erythematosus, callosities, clavus, and in the verrucous type of lichen planus.

Plaster mulls (or plaster muslins) are ready-made adhesive, plaster-like preparations. Such plasters are obtainable variously medicated. Salicylic acid adhesive plaster is useful for many localized hyperkeratotic conditions, particularly warts, callus, and corns.

The following formulas are taken from the Pharmacopeia of the Vanderbilt Clinic, and are those used by the Dermatological Department:

	Gm. or cc
gr. i =	.06
ʒi =	4
℥i =	30

1 cc. = ♏ xv
1 Gm. = gr. xv
1 full teaspoonful = 5 cc.

POWDERS

				Gm. or cc.
1.		Aristol (thymol-iodide).		
2.		Iodoform.		
3.	℞.	Zinc oxide.		
		Boric acid	each	4
		Starch	up to	30
4.		Stearate of zinc.		
5.		Zinc oxide and talc	equal parts	
6.		Salicylic acid powder.		
	℞.	Salicylic acid	3 parts	
		Powdered starch	10 parts	
		Powdered talc	87 parts	
7.		Anderson's powder.		
	℞.	Camphor		3.5
		Chloroform to dissolve.		
		Starch		60
		Zinc oxide		40

LOTIONS

				Gm. or cc
1.	℞.	Calamine powder prepared		16
		Zinc oxide		16
		Glycerin		16
		Lime water		16
		Rose water	up to	120
2.	℞.	Phenol		1.2
		Menthol		0.1
		Prepared calamine powder		16
		Zinc oxide		16
		Alcohol, 10 per cent	up to	120
3.		Pusey's calamine liniment.		
	℞.	Phenol		2
		Camphor		2
		Liq. petrolatum		120
		Powdered tragacanth		4
		Water	up to	240
		Mix. Make emulsion and add—		
		Talc powder		30
		Calamine		30
		Water	up to	240

			Gm. or c.c
4.	Antipruritic lotion.		
	℞.	Coal tar solution (Liq. carbonis detergent)	20
		Dilute hydrocyanic acid	15
		Comp. tr. of benzoin	8
		Alcohol, 30 per cent	up to 240
5.	Resorcin scalp lotion.		
	℞.	Solution of coal tar	8
		Resorcin	5
		Castor oil	2
		Alcohol	up to 120
		Oil of bay	4
6.	Mercury scalp lotion.		
	℞.	Bichloride of mercury	15
		Tr. cantharides	10
		Tr. capsicum	15
		Alcohol, 95 per cent	up to 120
7.	Sabouraud's carbon bisulphide lotion.		
	℞.	Sulphur	10
		Carbon bisulphide	100
		Carbon tetrachloride	200
8.	Lotio alba No. 1.		
	℞.	Sulphurated potash	4
		Sulphate of zinc	4
		Water	up to 120
9.	Lotio alba No. 2.		
	℞.	Sulphate of zinc, saturated solution	60
		Sulphurated potash, saturated solution	60
		Mix. Let stand twenty-four hours and discard supernatant fluid and add—	
		Resorcin	4
		Cologne water, q. s.	
10.	Cinnabar and sulphur lotion.		
	℞.	Red mercuric sulphide	1
		Sulphur	5
		Zinc oxide	15
		Talc	15
		Glycerin	50
		Alcohol, 50 per cent	up to 100
11.	Thymol and cinnamon lotion.		
	℞.	Resorcin	1
		Thymol	1
		Essence of cinnamon	2
		Alcohol, 50 per cent	up to 120
12.	Alibour's lotion.		
	℞.	Sulphate of copper	2
		Sulphate of zinc	7
		Camphor water	300
		One or two tablespoonfuls to a glass of water.	
13.	Camphor hand lotion.		
	℞.	Soap liniment Glycerin	each 30
		Spirit of camphor Water	each 90
14.	℞.	Crude petroleum Cotton seed oil	equal parts
15.	Black wash.		
	℞.	Calomel	2
		Lime water	300

SURGICAL SOLUTIONS

1. Aluminum acetate, 5 per cent.
2. Alcoholic gentian violet, 2 per cent.

			Gm. or cc.
3.	℞.	Acriflavine	5
		Sodium chloride	9
		Water	up to 1000

4. ℞. Balsam of Peru, Castor oil . . . . . equal parts

5. Camphor-phenol (Schlumsky's).

℞.	Gm. or c.c.
Camphor	60
Carbolic acid	30
Alcohol	10

6. Carbolic acid, 95 per cent.
7. Dakin's solution.
8. Dichloramin-T, 5 per cent in chlorcosane.
9. Borated glycerin, 10 per cent.
10. Glycerite of ox gall.
11. Tincture of iodine, 10 per cent in glycerin.

12. ℞.

Bismuth subcarbonate	20
Acacia	3
Cotton seed oil	80

13. Hydrogen peroxide.
14. Lysol.

15. (Myrrh wash.)

℞.	
Sodium bicarbonate	8
Tincture of myrrh	30
Water	up to 500

16. (Red wash.)

℞.	
Zinc sulphate	48
Compound tincture of lavender	15
Water	up to 120

17. Silver nitrate, 10 per cent.
18. Sodium iodide, 12 per cent.
19. Solargentum, 10 per cent.
20. Solargentum, 20 per cent.

21. Thiersch's solution with menthol.

℞.	
Menthol	2
Alcohol	50
Salicylic acid	2
Boric acid	12
Water	1000

22. Benzine.
23. Boric acid, 4 per cent.
24. Sodium hyposulphite, saturated solution.
25. Benzyl alcohol, 2 per cent.
26. Formalin, 4 per cent.
27. Solution mercurochrome, 2 per cent in 50 per cent alcohol.
28. Solution acriflavine, 1 per cent in 50 per cent alcohol.
29. Potassium permanganate, 0.065 tablets.
30. Potassium permanganate, 1.0 tablets or powder.

(The above are for making wet dressings or for baths.)

OINTMENTS

1. Balsam of Peru, 10 per cent in petrolatum base.
2. Boric acid, 10 per cent in petrolatum base.
3. Chrysarobin, 1 per cent in petrolatum base.
4. Chrysarobin, 5 per cent in petrolatum base.
5. Chrysarobin, 10 per cent in petrolatum base.
6. Ichthyol, 10 per cent in basilicon ointment.
7. Ichthyol, 20 per cent in basilicon ointment.
8. Iodine, 10 per cent in petrolatum base.
9. Ammoniated mercury, 5 per cent in petrolatum base.
10. Ammoniated mercury, 10 per cent in petrolatum base.
11. Ammoniated mercury, 25 per cent in petrolatum base.
12. Mercurial ointment, 25 per cent in petrolatum base.
13. Mercurial ointment, 50 per cent.
14. Calomel ointment, 30 per cent.
15. Pyrogallol, 5 per cent in petrolatum.
16. Pyrogallol, 10 per cent in petrolatum.
17. Scarlet red ointment, 1 per cent.
18. Sulphur, 5 per cent in Lassar paste.

	Gm. or cc.	
19. Sulphur ppt	1	5
Lassar paste	30	
20. Phenol, 1 per cent.		
Sulphur, 10 per cent in petrolatum base.		
21. Sulphur, 25 per cent in petrolatum base.		
22. Salicylic acid, 6 per cent in petrolatum base.		
23. Salicylic acid, 2 per cent in petrolatum base.		
24. Zinc oxide ointment, 20 per cent in lard.		
25. Oil of cade, 5 per cent in zinc oxide ointment.		
26. Oil of cade	4	
Sulphur	4	
Petrolatum	22	
27. Naftalan (Stiewe)	3	
Lassar paste	30	
28. Naftalan	15	
Starch	7	5
Zinc oxide	7	5
29. Carboneol	3	5
Lassar paste	30	
30. Crude coal tar	1	6
Zinc oxide	1	6
Starch	13	
Petrolatum	14	
31. Crude coal tar (undiluted).		
32. Acid salicylic	1	5
Sulphur	1	5
Petrolatum	30	
33. Cinnabar-sulphur ointment.		
Red mercuric sulphide	0	3
Sulphur ppt.	1	5
Petrolatum	30	
34. Wilkinson's ointment.		
Prep. chalk	3	
Beechwood tar	4	5
Sulphur ppt.	4	5
Green soap	11	
Lard	11	
35. Dilute Wilkinson's ointment.		
Wilkinson's ointment	1 part	
Lassar paste	2 parts	
36. Whitfield's ointment.		
Salicylic acid	2	
Benzoic acid	4	
Petrolatum	30	
37. Whitfield's ointment—½ strength.		
Salicylic acid	1	
Benzoic acid	2	
Petrolatum	30	
38. Salicylic paste, 30 per cent.		
Salicylic acid	10	
Zinc oxide ointment	20	
39. Solution of aluminum acetate, 1 per cent	40	
Anhydrous lanolin	40	
White petrolatum	20	
40. Cold cream.		
Spermaceti	6	
White wax	12	
Liq. petrolatum	50	
Borax	1	
Rose water	20	

		Gm. or c.c.
41.	Anhydrous lanolin	22
	Albolene	4
	Boroglyceride	4

42. Lassar paste.

Zinc oxide	8
Starch	8
White petrolatum	30

43. Lassar paste with phenol.

Phenol	6
Zinc oxide	8
Starch	8
Petrolatum	30

44. Bismuth and zinc.

Zinc oxide	3
Bismuth subnitrate	3
Simple ointment	12
Cold cream	12

45. Anesthesin.

℞.	Para-amido-ethyl benzoate	3
	Lanolin Petrolatum } each	15

46. For blepharitis.

℞.	Salicylic acid	3
	Yellow oxide of mercury ointment	2
	Albolene Vaselin } equal parts up to	180

47. White's coal tar paste.

℞.	Crude coal tar	5
	Zinc oxide	5
	Cornstarch	40
	Petrolatum	40

MISCELLANEOUS

1. ℞.	Chrysarobin	6
	Traumaticin up to	30

2. Zinc gelatin (Unna's).

℞.	Zinc oxide	100
	Gelatin	60
	Glycerin	140
	Water	220

Drugs.—The following drugs are used in *intravenous treatment* and should be available in ampules:

- Arsphenamine
- Neoarsphenamine
- Silver arsphenamine
- Tryparsamide
- Sodium thiosulphate
- Sodium gynocardate
- Chaulmoogra oil esters (chaulmesterol)
- Antimony and potassium tartrate.
- Gold sodium thiosulphate

For Intramuscular Injections:

- Mercury salicylate
- Mercury bichloride
- Bismuth metal
- Bismuth-phenol sulphonate (bismudol)

ORAL ADMINISTRATION

Gm.

1. Thallium acetate ampules.............................0.001 and 0.01 and 0.1
2. Mercury protiodide tablets.............................0.01 and 0.005
3. ℞. Mercury bichloride.............................|003
   Potassium iodide.............................|6
   Compound syrup sarsaparilla and water.................. up to 4|
   Dose 4
4. Potassium iodide solution
   Saturated solution
   Dose 0.6 = 0.6
5. Sodium iodide solution
   Saturated solution
   Dose 0.6 = 0.6

For the present the following preparations, mostly proprietary, are required in ampules. However, their value is as yet not firmly established:

Aolan (lact. albumen).
Afenil (calcium for intravenous use).
Ekzebrol (strontium bromide).
Krysolgan (synthetic gold preparation).
Tryphal (synthetic gold preparation).

Salicylic solution for inducing thrombosis.
Sodium salicylate.. 1|8
Cocaine hydrochloride.. |05
Aqua dest.. 6|

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CHAPTER VI

ROENTGEN-RAY THERAPY

Wide Use of Radiation.—The value of roentgen rays in the treatment of dermatological affections is well recognized. In fact, they are now considered the most useful and successful single remedy available for the treatment of skin diseases. While regarded as a versatile agent of the highest therapeutic service, roentgen rays should not be used to the exclusion of other remedies, nor be considered a panacea for all diseases.

In eighty-one dermatoses roentgen radiation is applied with various degrees of benefit.[1] Crutchfield concludes that, in his experience, about 60 per cent of all chronic dermatoses are relieved or improved by their use.

In addition to the various diseases that are responsive to roentgen rays, there is a group in which radiation offers the sole means of establishing a permanent cure with a reasonable degree of certainty, and in the case of other skin affections it is the most useful treatment although the results are not permanent. Irradiation in certain diseases will accomplish as permanent cures as surgery, and sometimes combined with it is more effectual than surgery alone.

Whatever the definite influence of roentgen rays on living tissues—about which there is considerable divergence of opinion—in dermatology they have a peculiar therapeutic power, of which only the effect is known in various pathologic conditions. Cutaneous lesions of the most diversified types, showing no relation in causation and structure, are responsive to roentgen-ray treatment.

Roentgen Ray, a Form of Energy.—When using roentgen rays in the treatment of disease, it is important to realize that one is dealing with electromagnetic waves, a form of energy the intricate properties of which are relatively unknown. However, the routine use of them with a certain technic yields practically uniform results and these gradually instil in the operator a feeling of security and simplicity about the whole process. Such an assumption is hazardous, for the process may become dangerous if any of the laws of technic are slighted. Radiotherapy has reached a stage of development where it entails sufficient safety in application, constancy of dosage, and uniformity of results to warrant its universal use; but it still lacks enough simplicity and accuracy of technic to make it invariably harmless. In large clinics and private practice where the number of exposures may be several hundred year after year, some trouble is sure to occur in spite of our best efforts and care. Exhausted, tormented patients who have felt the relief given by x-rays, beg for more and more treatments, and the limits of safety for repeated small doses are not well defined, so that the judgment of the physician is taxed to the utmost and he bears a burden which is not appreciated by the patient, or by others who are not familiar with this branch of medicine. In addition to such demands upon the operator's experience and judgment, he is most likely to meet with cranks and extortioners in dealing with such a large group of patients indiscriminately, as a doctor is traditionally inclined to do "without regard to race, creed, or color." Also technical accidents due to human fallibility are certain to arise, but in this respect radiotherapy may be regarded as any other public utility.

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[1] MacKee, G. M., and Andrews, G. C.: Value of x-Ray Therapy in Dermatology, Am. J. Roentgenol., 9: 241–246, April, 1922.

Atoms are composed of small electrical particles called electrons. Each atom is considered as consisting of a nucleus charged with positive electricity and of peripheral electrons charged with negative electricity. Electrons in mass are electromagnetic energy. If the negative electrons are in preponderance, the atom is negative electrically; if the nuclear mass carries the greater electrical charge the atom is positive. When molecules of gas or fluid become dissociated or split up into atom groups of positive or negative preponderance, the positive ions are attracted by the negative electrode and the negative ions by the positive electrode. The conveyance of any amount of electricity from one location to the other is considered an electrical current. Electrical conduction in metals is a flow of electrons; while in solutions or in gases the electricity is carried by the ions. When both negative and positive particles are present, the flow is in both directions simultaneously; in the absence of either, the flow is in one direction. A direct current is one which flows in a steady stream without any change in direction; a pulsating unidirectional current is one which flows in the same direction, but with change in magnitude, whereas in an alternating current both the direction and the magnitude are changing at certain fixed intervals, which in the ordinary power circuit generally take place sixty times a second. (Fig. 54.) With each change in velocity of an electron, electromagnetic vibrations are given off, and when these are short enough in wavelength they are within the spectrum of *x*-rays (approximately 50 to 1/10 Ångström units). By the researches of physicists the *x*-ray range is fast being extended toward the short wavelength end of the ultraviolet, but in practical therapy *x*-rays of a length above 2 Ångström units do not generally penetrate the glass walls of an *x*-ray tube.

In an *x*-ray tube the electrons are propelled in a stream from the negative electrode (cathode) and driven rapidly against a target (anode), where their velocity is suddenly stopped or tremendously modified by the collision. The change in velocity gives rise to the undulations of the ether called *x*-rays or roentgen rays. The mechanical energy of the cathode stream is transformed partly into caloric energy and partly to produce the ethereal undulations or *x*-rays. The total intensity of emission from various targets is approximately proportional to the atomic number of the element forming the target. Consequently the anode is made of very dense material, usually tungsten.

The theory has been generally accepted that *x*-rays, like rays of visible light and ultraviolet rays, are electromagnetic vibrations or undulations, only of shorter wavelength. The work of Planck, Einstein, and Compton supports a more recent quantum theory as to the nature of light. Visible light rays, *x*-rays, and gamma rays are said to consist of "streams of minute, discrete particles" shot with tremendous speed from their source in definite directions.[1] These quanta or particles are concentrated bundles of energy. In the place of wavelength we have momentum or energy carried by the particles; a quantum of hard *x*-ray having a comparatively large momentum, a soft *x*-ray quantum a small momentum. According to Compton, the mass of a hard gamma-ray quantum has been estimated to be about the same as that of an electron; the ordinary *x*-ray quantum about one-twentieth as great, and that of light, about one two-hundred thousandths as great. Instead of considering light rays and *x*-rays as waves, the quantum theory conceives them as "streams of tiny bullets or arrows shot with tremendous speed from the target of our tubes." However, v. Laue[1] by experiments with crystals has succeeded in diffracting x-rays and in proving that they are physically similar to the gamma rays from radioactive substances, ultraviolet light, visible light, heat waves, and radio-waves. Kaye[2] summarizes the present state of the problem as follows:

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[1] Compton, A. H.: Scattering of *x*-Rays, Radiol., 3: 481, Dec., 1924.

> "The difficulties, conspicuous with the x-rays, have merged into those which all classes of electromagnetic waves are found to present in greater or less degree, and the full secret of the nature of x-rays will doubtless be revealed when we find the key to the overshadowing problem of the mechanism of radiation in general. We have seen that the problem of the transference of energy by ether-waves involves us in the conception of a 'quantum' of energy-radiation traveling undissipated through space. The reconciliation of the idea with the older and well-founded conception of spreading waves remains. The experimental evidence seems to indicate that both theories are true simultaneously: that radiant energy is both concentrated and indivisible, and at the same time spreads and is divisible. The keynote of the old mechanics is, in fact, continuity; of the new mechanics, discontinuity. Any hope of a compromise between the two theories appears to involve concessions fatal to either."

Regardless of these hypotheses explaining the nature of x-ray energy, there is no doubt that the whole of it is finally converted into heat.

The *characteristic qualities* of the roentgen rays, physical and chemical, are: They are invisible; they spread in a straight line in all directions, and are not to be deflected by magnetic influence and only slightly by a prism; they produce heat and excite fluorescence and phosphorescence in certain materials, and penetrate all matter according to its density, mass, and electrical properties; they produce secondary rays in the medium impinged upon, have a chemical action, such as blackening a photographic film, and have definite biochemical and biological effects.

The nature of x-rays may not be definitely known, but the laws governing their effects upon matter are fairly well established. So if the exact nature of a cell were known and all of its electrical elastic and mechanical constants determined, the effect of any particular wave-length upon it might be predicted. A given x-ray may have different effects upon two kinds of matter, the effect being determined by the properties of each. The direct effect of an x-ray upon matter is the ejection of an electron from an atom or molecule. This electron in returning to its normal position may in turn produce light rays, heat rays, chemical action, or even produce other x-rays (of equal or greater wavelength, generally greater, never less).

PRODUCTION OF x-RAYS

Tubes.—Gas tubes are not suitable for accurate therapy because they afford no exact means for the regulation of output. Hot cathode tubes which are highly exhausted and depend upon the heated tungsten to supply electrons, on the other hand, offer an accurate control of output. In America, the Coolidge tube, universal type, is used almost exclusively in dermatological work. It can be obtained with either a fine, a medium, or a broad focus. A broad or medium focus is preferable for therapy, the fine focus being intended for radiography. The hot cathode tube is exhausted to a much higher degree than the gas tube, being depleted to a degree of about 1/1,500,000 of our sea level air pressure, so that practically no residual gas remains, the electrons being supplied solely by the hot cathode. It is probably true that very small amounts of residual gas are present in most tubes, although such gas may not be indicated by fluorescence. This residual gas generally shows in the anode arm and in this location causes no difficulty. It is only when the gas gets into the bulb or into the cathode arm that the tube should be considered too gassy to operate satisfactorily.

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[1] v. Laue, M.: Eine quantitative Prüfung der Theorie für die Interferenz-Erscheinungen bei Röntgenstrahlen Sitzungsberichten vom 8. Juni u. 6. Juli 1912 der Kgl. Bayerischen Akademie der Wissenschaften, mathemat.-physikalische Klasse.

[2] Kaye, G. W. C.: X-Rays, New York, Longman, Green & Co., 1923, p. 271.

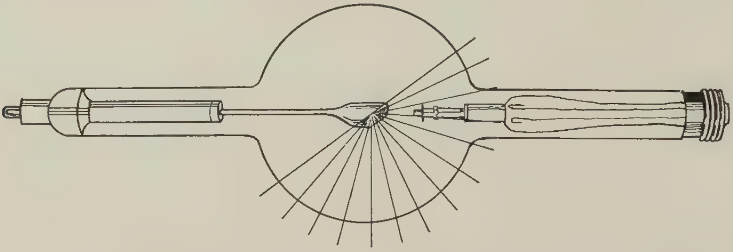

Fig. 48.—Schematic drawing of the Coolidge universal type *x*-ray tube.

The length of the bulb is 22 inches and the diameter 7 inches. The anode (target) is made of tungsten mounted upon a molybdenum rod. The polished surface of the anode, although smooth to ordinary vision, microscopically is irregular, and for masses the size of the electrons these irregularities assume immense proportions and enormously affect the changes in the velocity accorded them upon collision (Fig. 50).

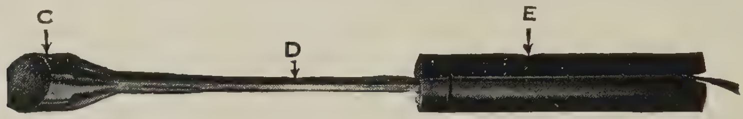

Fig. 49.—Anode of universal and therapy (air-cooled) type tubes; it consists of a solid piece of wrought tungsten (*C*) attached to a wrought molybdenum stem (*D*) which is in turn attached to a split metal tube (*E*) for support in the glass bulb.

The *cathode* is a spiral filament of tungsten wire within a molybdenum cup, which focuses the cathode stream of electrons by deflection toward the anode.

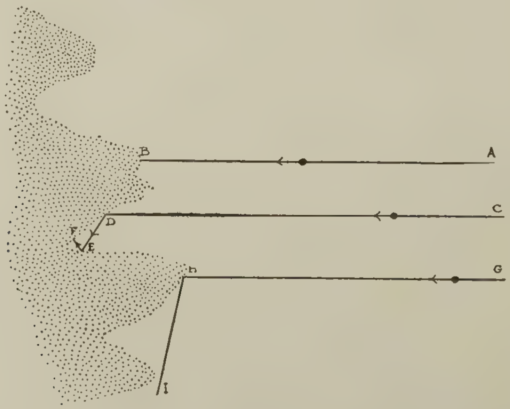

Fig. 50.—Diagram illustrating enlarged surface of anode and the course of impinging electrons.

The cathode must be very accurately made. A variation from the proper dimension, even so little as one-thousandth part of an inch, may make the focal spot too large or too small. When the tungsten filament of the cathode is heated, it gives off free electrons, their number depending upon the degree of heat of the tungsten. The amount of heat can be minutely and exactly regulated, so that the quantity of x-rays generated is easily and accurately controllable. This control is afforded by a choke coil or similar device in the *filament circuit*, which by varying the impedence in very fine gradations regulates the current passing through the filament and thus the temperature of it. The heating is produced by passing a low voltage current (10–12 volts) of 3 to 5 amperes through the filament wire, which circuit is *entirely distinct from the high voltage circuit* and can theoretically be replaced by some other means of heating. The filament circuit is analogous to that used in the ordinary tungsten filament electric light. In order to have the supply of electrons steady it is necessary to have an unfluctuating[1] filament current, which in modern apparatus is derived from a step-down transformer. The current which is supplied to this transformer is generally taken from the auto-transformer, but may be taken directly from the main line if the latter is alternating.

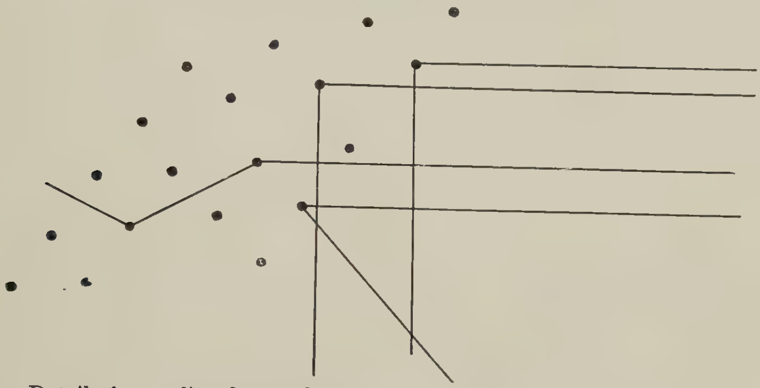

Fig. 51.—Detail of preceding figure, illustrating the course of electrons among the atoms of the surface of the anode.

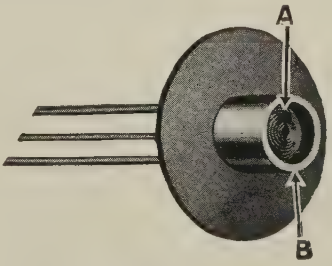

Fig. 52.—Cathode of Coolidge tube—filament (A) and focusing cylinder (B).

These sources are subject to fluctuations and as any change in the filament current effects a much greater change in the tube current, a device is necessary to maintain a constant milliamperage through the tube. This instrument known as a stabilizer is operated by the tube current itself, and changes the filament current by an amount sufficient to offset fluctuations in the line voltage and in the tube vacuum. It keeps the milliamperage constant regardless of the setting of the auto-transformer or rheostat, as well as the inherent drop, as the tube becomes heated.

Caught by the difference of potential (high voltage circuit) between the cathode and anode terminals the electrons are driven toward the anode. The stream of electrons—*cathode stream*—depends for its velocity upon the magnitude of the difference of potential; the greater the speed of the electrons, the greater the *change in their velocity* when they strike the anode. The wave-

[1] Strictly speaking, a direct current should be the only proper unfluctuating current, but practically 60 cycles alternating current is satisfactory, for with such high frequency there is no variation noticeable in the heating of the filament.

lengths of the x-rays produced by this collision have the following relation which gives only the value of the minimum wavelength:

$$\mathrm{Ve} = \frac{\mathrm{hc}}{\lambda\ \mathrm{min.}}$$

Where: V = difference of potential
e = electron charge
h = Planck's constant
c = velocity of light
λ min. = minimum wavelength produced

Substituting the values for e, h, and c in the above equation, we have the relation between the minimum wavelength and maximum voltage:

$$\lambda\ \mathrm{min.} = \frac{12.345}{\mathrm{Kv.\ max.}}\ \text{Ångström units}$$

The wavelengths produced by electrons under a difference of potential V lie between $\lambda = \infty$ and $\lambda = \lambda$ min. given by the above relation. The general radiation curves for different voltages are shown in Fig. 53.

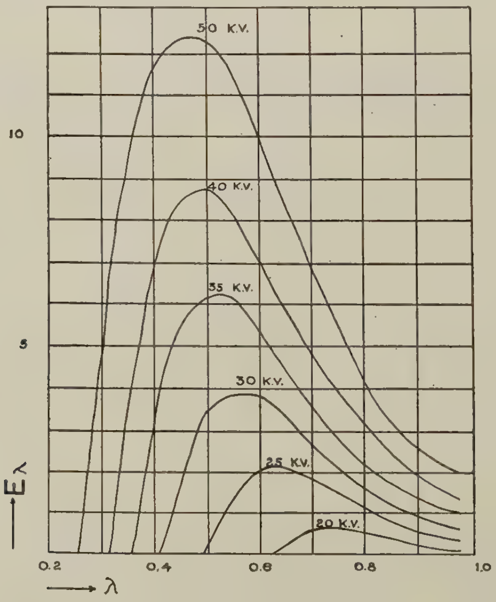

Fig. 53.—Curves which illustrate the general radiation for different voltages.

The wavelength of *maximum intensity* and the minimum wavelength are seen to move toward shorter lengths as the voltage increases. The law governing the movement of the wavelength of *maximum intensity* is not precisely known, but it is roughly *inversely* proportional to V.

For the Coolidge tube the wavelength intensity distribution is fairly steady and may be represented at all times by a curve of the above type. For the gas tube the typical curve changes frequently, *i. e.*, the wavelength intensity characteristic is not constant. Another type of Coolidge tube, called the radiator type, has been employed for therapy, but has not proved serviceable because of variability in its output. Oil-immersed tubes have also not proved of practical importance in superficial therapy.

Generators.—To produce an initial rapid speed for the electron before it strikes the target, a great difference of potential must necessarily be created between the cathode and the anode of the x-ray tube. The volt is the unit of electromotive force employed to measure difference of potential. Inasmuch as the voltage used in therapy ranges from 50,000 to 200,000 volts, that of the ordinary street current is not high enough to be connected directly to the terminals of the tube. A suitable voltage is obtained by raising that of the street supply by the use of a step-up transformer, which is a stationary device for changing the magnitude of the voltage. The transformer consists of an iron core having two windings, a primary and a secondary. The high tension circuit is thus the secondary of the transformer.

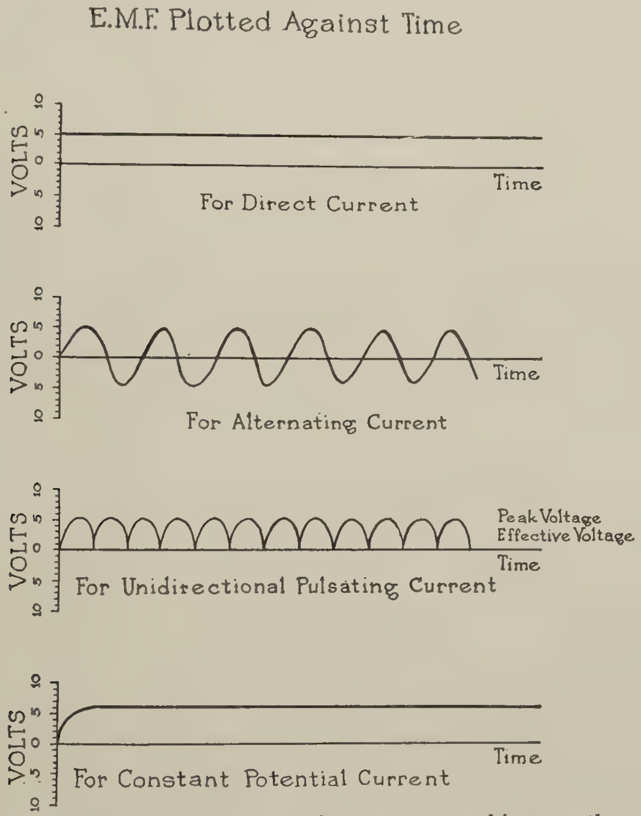

Fig. 54.—Graphic illustration of various currents used in x-ray therapy.

When the transformer is used for raising the voltage the secondary winding has a great number of turns, as the voltage thus induced is equal to the primary voltage multiplied by the ratio of the turns of the two windings. As the step-up transformer can be used only with alternating current it is necessary, wherever the incoming service is direct, first to change it to alternating by means of a rotary converter. This is merely a direct current motor and an alternating current generator combined in one unit; the direct current being applied to the motor end and the alternating current being taken out from the generator end. If only a high tension transformer were used the voltage across the tube would be fixed and determined by the step-up ratio of the transformer. As such inalterable voltage is undesirable, two controls are generally added; one, the resistance control, in which part of the voltage is converted into heat, and the second, the autotransformer, which is merely a special kind of transformer with one winding, arranged so that it is possible to change the transformation ratio. The resistance box called a rheostat is inserted in the line between the motor converter and the transformer. By increasing the resistance in the rheostat the current entering the transformer is diminished, indirectly affording control of the high tension current. This control by resistance is associated with loss of voltage, which becomes greater as the current is increased. To avoid this loss, preference over the rheostat is given to autotransformer control, which regulates the amount of current going into the transformer by the impedance of auto-induction. Although it is possible to operate with only the rheostat, both forms of control are preferable.

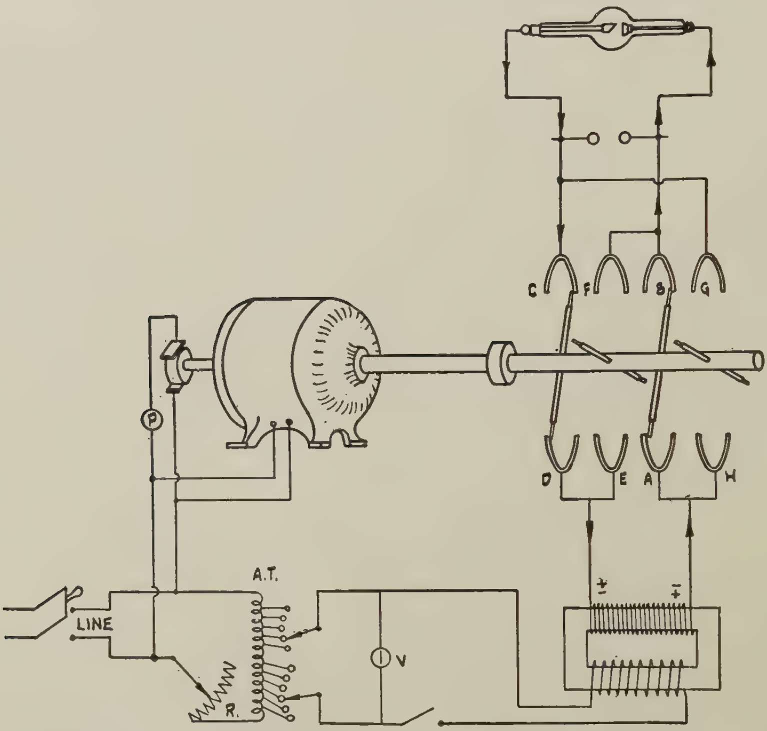

Fig. 55.—Diagram illustrating the primary and secondary circuits of an *x*-ray apparatus. Note mechanical rectifier (A to G), voltmeter (V), autotransformer (A.T.), and rheostat (R).

After the voltage is raised a further refinement is necessary in order that the *x*-ray tubes will not wear out quickly—the current must be rectified. By rectification is meant directing the current in such a way that the positive pole of the transformer is at all times connected to the anode of the tube and the negative terminal to the cathode. The target (anode) is especially designed to withstand bombardment by the electrons. It is made of a non-malleable substance, usually tungsten, and surrounded by metal of high thermal conductivity, generally molybdenum. The cathode, on the other hand, is a delicate tungsten filament, which would soon be destroyed if it were bombarded. For this reason, it is important that the electrons flow only toward the anode, for otherwise they would soon destroy the cathode. If the alternating current were connected directly with the tube, and the target should reach a high temperature, electrons would be liberated not only by the filament, but also by the target, causing an inverse current, which would produce *x*-rays both at the target and at the filament, with resulting damage to the latter. Also, inasmuch as the current across the terminals of the transformer is alternating, a tube connected directly to them would utilize only half of the wave if the current flowed through it in one direction. Rectifying devices either cut out the reverse current, which is not wanted, or change it so that it flows in the desired direction, the resulting current in either event being unidirectional, pulsating, and flowing only toward the target (anode).

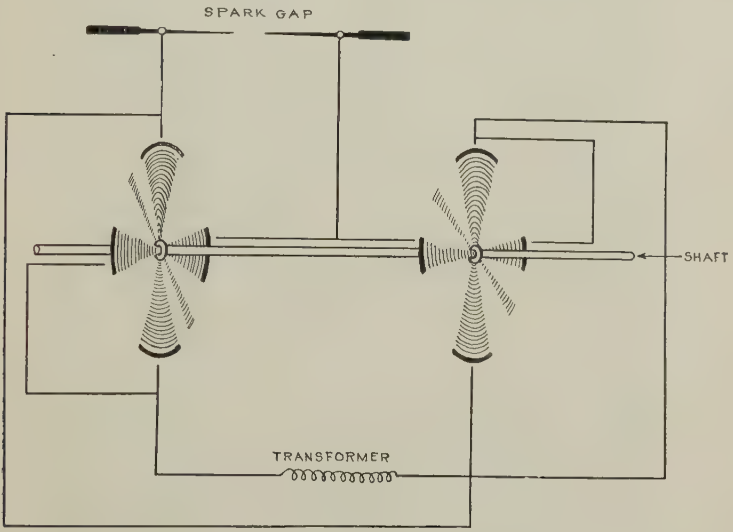

Fig. 56.—Drawing of disk rectifier.

According to the manner in which rectification is accomplished, machines may be divided into two main groups: (1) Those which are mechanically rectified, and (2) those which are rectified by valve tubes.

Mechanical rectification is accomplished by means of a revolving cross-arm, disk or toroid, which is attached to the shaft of the motor and works upon the principle of a commutator, changing each half wave of the alternating current (Fig. 54, 2), so that a unidirectional pulsating current (Fig. 54, 3) is formed. If the current supply is direct, the rectifier is attached directly to the shaft of the motor converter. If the supply is an alternating current, a synchronous motor, the speed of which is timed exactly with the frequency of the alternations, is used to keep the cross-arm or disk in a coincident position with each alternation of the current wave. A polarity indicator, which indicates direction of current flow, is ordinarily employed with alternating current machines using a rectifier, in order to avoid applying high tension across the tube in the wrong direction.

Mechanical rectification has the following advantages:

1. The up-keep is small.
2. It can stand a great deal of abuse at the hands of less experienced operators.
3. It is possible to measure the voltage directly by means of a spark gap without danger of damaging any part of the equipment.

Although mechanical rectification is considered accountable for the undesirable effects upon neighboring radio receiving sets, these do not occur beyond a radius of 150 feet when the rectifier is properly designed.

Valve tube or **Kenotron rectification** is achieved by the insertion, in the high tension circuit, of one or more hot cathode tubes of special construction but similar to the Coolidge tube, having the same characteristic of allowing the current to flow through in only one direction—provided the anode is cool. The action of the single valve tube machine consists of merely suppressing the undesired part of the alternating current wave from the high tension transformer. If two valve tubes and condensers are used, both parts of the alternating current wave may be utilized. This cannot be done unless condensers are included, for otherwise any arrangement which gives a current comparable with that of a mechanical rectifier consists, in reality, of two valve tube outfits in which a half wave is utilized from each alternately. If further condensers are added, it is possible to get a practically continuous voltage across the tube, the magnitude of which remains very nearly constant (Fig. 54, 4).

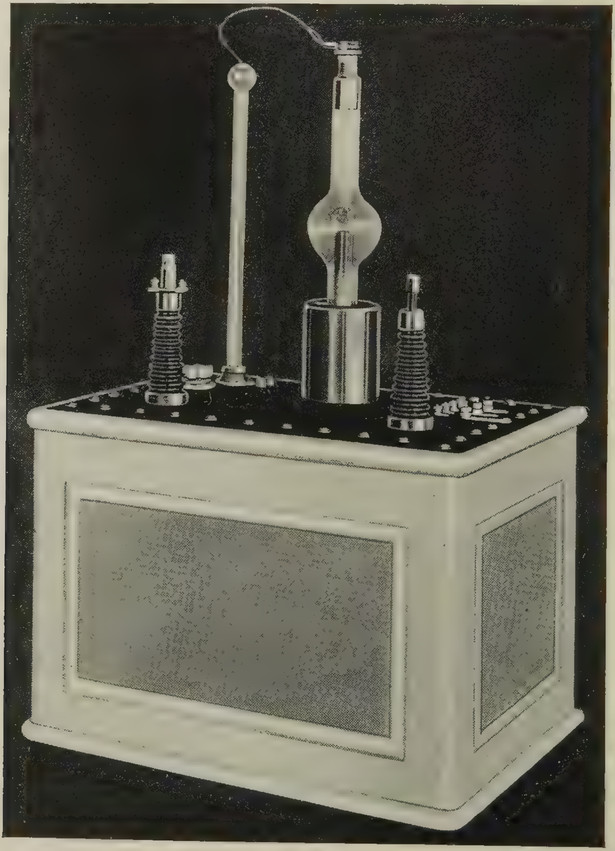

Fig. 57.—Valve tube rectified *x*-ray apparatus.

The valve tube rectification has the following advantages:

1. It is quiet.
2. The rotating parts do not require lubrication.
3. Where condensers of sufficient capacity are used the depth dosage is somewhat higher, operating with the same maximum voltage as the mechanical rectifier.

Disadvantages:

1. Replacement parts are expensive.
2. Manufacturers do not advocate the use of any direct means of measuring the voltage, which makes the determination somewhat complicated.
3. Due to the lack of any noise associated with the high tension, more care must be exercised to prevent accidental spark-over.
4. On valve tube machines connected with condensers it is necessary, after each treatment, to discharge these by a short circuiting device. If this is not done any person touching the tube or any part of the machine or overhead is liable to receive a very dangerous shock.

Control of Quantity and Quality.—Quantity of output is governed by the milliamperage and voltage passing through the x-ray tube. The total intensity of radiation varies directly as the milliamperage and as the square of the voltage. The quality of the radiation is not altered by a change of milliamperage within the usual variations in superficial therapy.[1] The most direct control of milliamperage in the secondary circuit is by means of the tungsten filament. The filament circuit has been described on page 105. If the temperature of the filament is raised, more electrons are given to the cathode stream. However, inherent characteristics of the Coolidge tube are such that the milliamperage which the tube will take is not directly proportional to the filament current. The amount of current going through the x-ray bulb is approximately measured by a meter placed in the high tension circuit, which registers in milliamperes. This so-called "milliammeter" is a delicate instrument readily subject to disorder, especially from accumulated static electricity. It is necessary to use two of them upon the same line in series, so that if one gets out of order the other will show a reading which does not harmonize with it. When both instruments show the same reading, it is likely to be an accurate index of the current going through the tube, although occasionally both milliammeters may have the same defects and register an error synchronously. For the purpose of checking such errors, it is advisable to test both milliammeters monthly with a third one of known accuracy, which may be obtained from the factory; or an old well-standardized milliammeter may be kept on hand to be placed in series with the other two milliammeters on the machine and a comparison of readings made.

Possible discrepancies in milliameter readings may be due to losses of current sustained from leaks in the high tension circuit, inverse current, or electrostatic forces influencing the needle owing to improper shielding or the accumulation of dust.

As we have seen, when roentgen rays are produced they are a mixture of emanations of varying wavelengths (quality). The relation of wavelength to voltage is expressed as $\lambda = \frac{\text{Constant}}{\text{V}}$. The shorter the wavelength of the x-rays, the more penetrating (the harder) they are and the more energy they possess; and *vice versa*—the longer the wavelengths, the "softer" and more superficial the action. The greater the electromotive force upon the electrons emitted by the cathode, the greater is the velocity of the electrons in the cathode stream. Consequently, the quality of the x-rays is changed through the control of the voltage.

Changes in the milliamperage going through the tube necessitate alterations in the primary current in order that the voltage across the tube may remain the same. An increase in milliamperage requires an increase in the primary current, and a decrease in milliamperage a corresponding change. This is brought about by regulations of the rheostat in the primary circuit.

A voltmeter placed across the primary circuit of the transformer indicates the line voltage and permits the operator to correct any fluctuations in it by changing the controls.

It is customary for the manufacturer to supply the purchaser with tables based upon spectroscopic measurements for the particular apparatus, stating the relationship between the voltage of the primary circuit and the voltage of the secondary circuit which supplies the tube, at various spark gap and current values. Such calibration charts are corrected for altitude, humidity, and temperature changes. Inasmuch as the secondary voltage, as well as its wave form, is somewhat modified by the length of the overhead and the local conditions of the installation, the calibration done at the factory is not sufficiently accurate to be relied upon and the habit of some roentgenologists to quote their voltage in voltmeter readings is undesirable.

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[1] With wide changes in milliamperage the wave form is changed, and consequently the intensity is not always strictly in proportion to the milliamperage.

When mechanically rectified the high tension current, which is connected with the terminals of the x-ray tube, usually has in its circuit a *parallel spark gap* used to estimate the voltage of the high tension circuit. Corrections must be made for climatic conditions, but the equipment for clinical use is too crude to permit much accuracy. In modern apparatus reliance is placed largely on voltmeters connected with the primary transformer circuit, and when valve tubes are used for rectification the spark gap is omitted for the reason of safety.

The *spark gap* consists of two metal electrodes, the distance between which is adjustable and the ends of which are either pointed, bluntly pointed, or spherical. This spark gap acts as a safety valve across which the spark jumps if there are not enough electrons in the tube to carry through the current supplied. The spark gap measures only the crest of the wave, and the voltage indicated by it is the peak rather than the effective voltage. As a spark jumps more freely from pointed than from blunted or rounded ends, it is not possible to compare the voltage of one machine with another on the basis of the spark gap distance, machines of different manufacture having spark gaps of different shapes. Thus, in order to make a spark jump between them, large metal balls with a distance of 2 inches may require a difference of potential as great as pointed electrodes of a 10-inch spark gap. A spark gap between spherical electrodes of equal size is preferable to that between points. The spark between points is now generally discredited for high voltages on account of its inconsistent dependency on atmospheric humidity and frequency of discharge. Sphere gaps are less influenced by these factors and are preferable for all purposes. The size of the spheres is important, a good rule being to use no gap greater than the diameter of either sphere. With proper precautions a sphere gap is capable of measuring voltages from about 10,000 to 500,000 volts to an accuracy of about 2 per cent.[1]

Greater speed and convenience in voltage measurements are obtained by the use of a magnetic sphere gap. This type of gap is so arranged that by pulling a cord one sphere is made to move slowly toward the other. A scale, calibrated in kilovolts, simultaneously moves past the indicator, which is magnetically controlled so that at the very instant the first discharge passes across the gap the indicator becomes fixed to the scale and moves with it. It therefore shows the exact kilovoltage at which the spark-over takes place. By this arrangement any error due to not stopping the movement of the sphere gap at the very instant the spark-over occurs, has been eliminated.

The most accurate method of determining the voltage between the electrodes of an x-ray tube is to take a photographic spectrum of the radiation, to measure from it the minimum wavelength, which is known to depend upon the peak voltage, and then by means of the Planck-Einstein equation, to calculate the kilovoltage.

Quality is also modified by the type of individual structure of the x-ray tube that is used. The output of different Coolidge tubes of the same type may vary slightly, but, on the whole, no variations of any importance exist. The clinical effects of different Coolidge tubes of the same type are surprisingly uniform.

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[1] Kaye, G. W. C.: x-Rays, New York, Longmans, Green & Co., 1923, p. 100.

TABLE 1

Sphere-gap Spark-over Voltages

(At 25 C. and 760 mm. Barometric Pressure)

(Sinusoidal R. M. S.) kv.	Sparking distance in millimeters.					
	125 mm. spheres.		250 mm. spheres.		500 mm. spheres.	
	One sphere grounded.	Both spheres insulated.	One sphere grounded.	Both spheres insulated.	One sphere grounded.	Both spheres insulated.
60	30.9	30.7	29.7	29.6		
70	37.0	36.6	35.3	35.1		
80	43.6	42.8	41.1	40.7	40.4	40.2
90	50.7	49.4	47.1	46.5	45.8	45.6
100	58.9	56.3	53.3	52.5	51.3	51.0
120	79.5	71.5	66.4	65.0	62.4	61.8
140	108.2	89.1	80.4	78.2	73.6	72.8
160	148.7	111.1	95.5	92.3	85.1	83.8
180	.....	138.9	111.9	107.4	96.8	94.9
200	.....	.....	129.9	123.4	108.6	106.4
220	.....	.....	150.5	140.8	120.9	118.3
240	.....	.....	175.1	159.8	134.0	130.6

The above figures have been taken from the standards of the American Institute of Electrical Engineers. The following table of spark-over voltages for gaps between points is given in inches.

TABLE 2

Point-gap Spark-over Voltages (Approx.)

Sparking distance in inches.					
Kilovolts.		Altitude (feet).			
Peak.	R. M. S.	0	500	2000	4000
60	42.4	2.68	2.73	2.86	3.05
65	45.9	3.08	3.13	3.29	3.50
70	49.5	3.47	3.54	3.70	3.95
75	53.0	4.0	4.1	4.3	4.5
80	56.6	4.4	4.5	4.7	5.0
85	60.1	4.8	4.9	5.1	5.5
90	63.6	5.2	5.3	5.6	5.9
95	67.2	5.7	5.8	6.1	6.5
100	70.7	6.1	6.2	6.5	6.9
110	77.8	7.0	7.1	7.5	7.9
120	85.0	7.8	7.9	8.3	8.9
130	91.9	8.7	8.9	9.3	9.9
140	99.0	9.5	9.7	10.1	10.8
150	106.0	10.3	10.5	11.0	11.7
160	113.0	11.1	11.3	11.9	12.6
170	120.2	11.9	12.1	12.7	13.5
180	127.3	12.6	12.8	13.4	14.3
190	134.3	13.3	13.5	14.2	15.1
200	141.4	14.0	14.3	15.0	15.9

Filtration.—As a characteristic of roentgen rays is the penetration of all materials according to their density, thickness, and atomic properties, an added refinement to control the quality of the *x*-rays is the insertion of a more or less impermeable substance, usually metal, known as a filter. This is placed within the path of the beam of the radiation between the source and the object irradiated. In passing through such matter some radiation is lost by absorption and some by scattering. The filter intercepts and absorbs *x*-rays which are not penetrating enough to go through it, the coefficient of absorption being roughly proportionate to its density. Long wavelengths (soft *x*-rays) are absorbed to a greater extent than are short wavelengths (hard *x*-rays). In the case of a homogeneous beam an exponential law prevails, so that equal increases in thickness of the layer of the filter absorb equal fractions of the energy remaining.

Filtered *x*-rays, in an individual sense, possess no greater penetration than unfiltered ones from the same source. Filtration, however, does take out of the primary beam the softer wavelengths which would be completely absorbed in the superficial tissues. By removing these *x*-rays, filtration increases the average penetration and gives a more uniformly hard beam, which is more equally absorbed at any given depth. Regardless of the amount of filtration or penetration, the absorption is nevertheless always greater in superficial than in deep tissue. Filtration does not make possible the giving of a larger amount of radiation through one portal to deep lesions than to the superficial structures overlying them.

Besides those rays which pass unchanged directly through filters, there are others which only strike the molecules in the filter and have their directions and wavelengths altered. These rays are designated **scattered *x*-rays.** They are not entirely the same rays as the incident rays; they are mostly new rays produced by the incident rays impinging upon the scatterer. If there is no crystal structure to the filter, then (with the exception of a possible deviation in direction of a few seconds of an arc due to refraction), all the scattered rays are newly formed rays, *i. e.*, secondary. The incident beam also generates homogeneous secondary radiations in the metals impinged upon or passed through, characteristic of the metals and varying in energy according to the atomic weights. These are called **characteristic *x*-rays.** When copper and other filters of high atomic weight are used, it is necessary to protect against these secondary characteristic rays by the insertion of a supplementary filtering substance such as aluminum or leather between the heavy metal and the patient to absorb the secondary radiation.

EQUIPMENT

Treatment Room.—For the sake of the operator, as well as for the comfort of the patient, the *x*-ray room should be very light. Good light in the treatment room conserves the health of the operator and allows him to observe the skin carefully when treatment is administered, thereby diminishing his chances of superimposing further treatment upon an erythema. In this way the *x*-ray room may be used for observation as well as for treatment. It should also have proper ventilation, with window ventilators and door transoms, as vitiated air often causes headaches, nausea, and anorexia as a result of the ozone, nitrous oxide, and other gases emitted in the room. Dangers are minimized by the use of large rooms, the floors of which are covered with the proper kind of insulating material, such as wood, cork, or rubber.

Patients consume much time undressing and dressing and greatly appreciate privacy during the process. For this purpose, it is a matter of comfort to have two small ventilated dressing rooms connected with the *x*-ray treatment room and the hall, each containing a mirror, chair, clothes-tree, and shelf.

Coronaless tubing at a height of not less than 9 feet is recommended for the overhead conductors. All metal parts of the apparatus should be grounded. There are many advantages from the point of view of noise, as well as ventilation, in mounting all rotating machinery, and as much as possible of the high tension equipment, in an adjacent room.

In the *x*-ray room it is convenient to use a low leather-cushioned table. To this the tube-stand may be attached. A small cabinet with shelves underneath it placed behind the screen which shields the operator, is useful for holding equipment. Upon the shelves are placed the pieces of lead-rubber, a roll of sheet-lead, and pieces of sheet-lead which have been cut from the roll. Upon the top of the cabinet are lead spectacles, a ruler, a pencil, the patient's chart, prescription pads with sheets of carbon paper beneath the top sheet of each, towels, a watch with a second hand, a pair of pointed scissors, measuring sticks for anode-skin distance, and an interval-time alarm clock registering hours and minutes.

The walls of the *x*-ray room should be covered with sheet-lead. Barium sulphate plaster and other substitutes[1] for lead-sheeting are not recommended. The cost of covering a wall with plaster is higher than with a layer of lead of equal absorbing power. Besides, cracks which develop in barium plaster and are unrepaired or repaired with ordinary plaster, offer no resistance to penetration. Kaye believes that sufficient protection is afforded by "0.5 mm. of lead in ordinary surgical radiography," and presumably this also would be satisfactory for the voltages used in superficial therapy.

Choice of Apparatus.—For skin therapy a machine producing 170 kv. (peak voltage) will be found most serviceable. Such voltage corresponds approximately to a pointed spark gap of about 12 inches or a sphere gap of about 2½ inches, provided the diameter of the spheres is 12.5 cm. This type of apparatus will permit unfiltered treatments of low voltage and of low milliamperage and will also allow the use of a moderate filter with fairly high voltage. The well-known American machines of modern make have merits so nearly equal that the choice of a particular one should depend upon the nearness of the factory and the excellence of the service available to the physician from the factory after the installation is made.

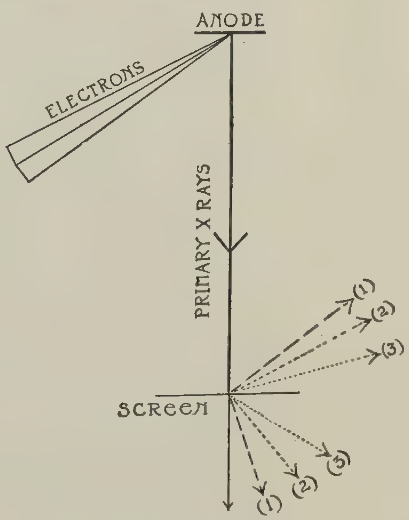

Fig. 58.—To show primary and secondary *x*-rays and electrons. The cathode particles strike the anode (or anticathode) and cause the formation of primary *x*-rays in the *x*-ray tube. These passing out of the tube strike the metal screen interposed in their path. A part passes straight through unaltered in deviation or character as shown by the prolongation of the path of the primary rays through the screen. A portion is "scattered" (1), secondary characteristic rays are given off (2), and secondary electrons are given off (3). Note that (1), (2), (3) occur on both sides of the screen. (From Colwell and Wakeley.)

For dermatological work apparatus delivering 140 kv. (peak) is in general use. Higher voltages[2] are desirable only in the treatment of cancer to obtain an effective dose 1 or more centimeters beneath the skin, and require a machine of greater dimensions in order to allow larger clearances between opposite potentials. It is further necessary to use a special tube, the deep therapy tube, designated for operating at such voltage. Because the *x*-rays thus produced have such a high penetrating power, the use of an enclosed tube holder is recommended, which prevents the radiation from escaping except through an aperture directed toward the patient. If an open type tube-stand is employed, great care should be taken to allow plenty of clearance between the patient and the terminals of the tube.

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[1] Whittington, J. W.: Some Experiments in *x*-Ray Protection, J. Radiol., 5: 347–352, Oct., 1924. Kaye, G. W. C.: Some Fundamental Aspects of Roentgen Rays and the Protection of the Roentgen-ray Worker, Am. J. Roentgenol., 18: 421, Nov., 1927.

[2] Jean, R.: Deep Radiotherapy in Dermatology, Paris méd., 53: 132–134, Aug. 9, 1924.

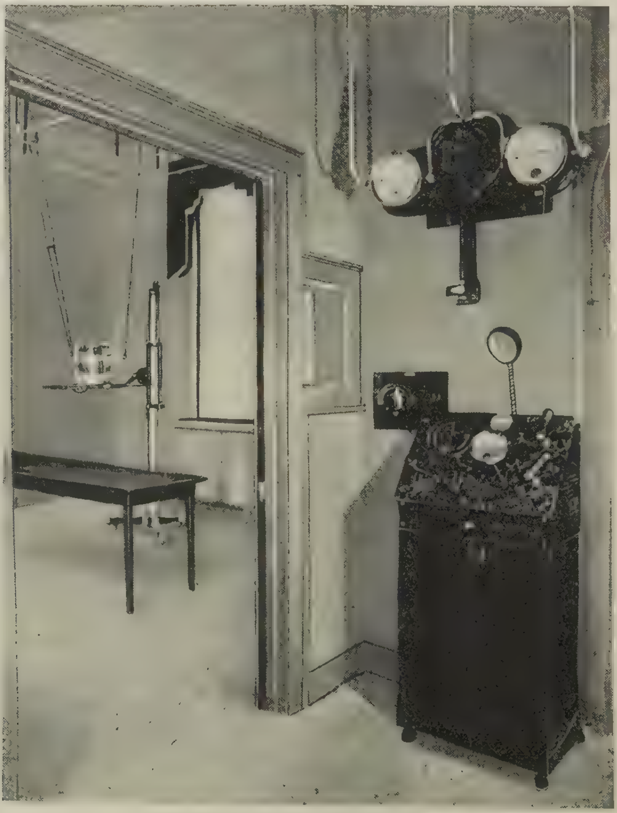

Fig. 59.—Installation for superficial *x*-ray therapy.

As the aim in skin cancer therapy is to give the greatest amount of radiation at the site of the lesion, it is desirable to use a radiation as homogeneous as possible. For this reason a copper filter $\frac{1}{4}$ to $\frac{1}{2}$ mm. thick is generally used. One millimeter of aluminum filter is usually added on the side facing the patient in order to absorb the characteristic radiation given off by the copper. The exact thickness of the filter depends upon the quality of radiation wanted. The deep therapy tubes are of the same pattern as the universal type, but are larger and of two kinds—the air-cooled and the water-cooled. The air-cooled is designed to operate at around 4 ma., while the water-cooled is generally used around 30 ma. at 200,000 volts. The water-cooled tube requires a special cooling arrangement, and this has the advantage that the treatment time is cut down materially. The water-cooled tube, on account of its high cost, is recommended for use only in a busy hospital or cancer institute, where the time factor is of major importance.

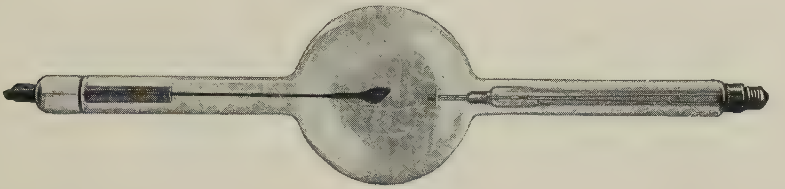

Fig. 60.—Air-cooled "deep therapy" Coolidge *x*-ray tube. It is 8 inches in diameter and its length over all is 31 inches (so as to avoid sparking between the terminals with the very high voltage).

Care of Apparatus.—For disorders of the high tension circuit it is usually necessary to call on the factory for service. The operator, however, may often correct difficulties in the Coolidge filament current. Frequent disorders in this circuit are caused by broken wires, loose connections, especially from carbon and dust deposits on the aerials, from a loosening of the socket upon the cathode end of the tube, and short circuits.

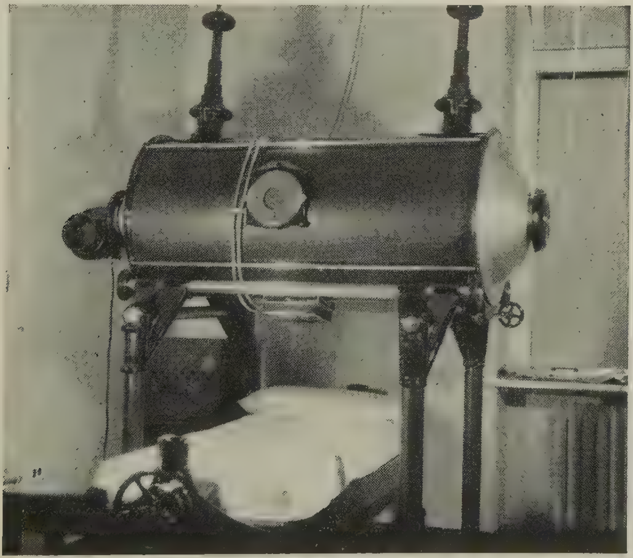

Fig. 61.—Metal grounded housing for "deep therapy" tube with Weatherwax ionization chamber permanently attached.

With modern stands tubes are very rarely burned out or broken. The *x*-ray tube and the top of the machine should be dusted daily. Dust and carbon should be cleaned from the inside of the cabinet weekly, and at the same time the oil cups should be replenished.

TECHNIC

Protection.—The problem of adequate **protection**[1] for the operator against undue exposure may be divided into two parts: (1) That of avoiding possible local burns, as on the fingers and hands, and (2) avoiding such intensities of radiations throughout the office as might, through prolonged exposure, produce general or systemic effects on those exposed. Certain conditions—moderate leukopenia, lymphocytosis, polycythemia, and asthenia, occasionally eosinophilia, considered as resulting from undue exposure—demand increased protection. Low blood pressure also has been found to be common among radiologists.

A simple method of detecting whether one is being overexposed is to carry a dental film in one's pocket for about two weeks. If it becomes fogged or darkened, it is an indication that increased protection is needed. In the light of modern technic, complete protection is not only needed but can be provided.

Local burns on the operator can be caused only by carelessness and occur principally in fluoroscopic work. Avoidance of general or systemic effects to the operator or those employed about the laboratory is accomplished solely by adequate shielding from the roentgen beam. A lead screen providing protection for the operator should be faced with aluminum or aluminum paint or wood to absorb the secondary lead rays, which, although soft, might possibly be harmful to him. This may not be needed if the lead is sufficiently thick to absorb the radiation. He should remain behind this screen throughout the exposure, and as far away from the tube as possible. When voltages higher than 140 kv. are routinely used the lead protection screen is insufficient, and a special control room with sheet-lead protection is necessary.

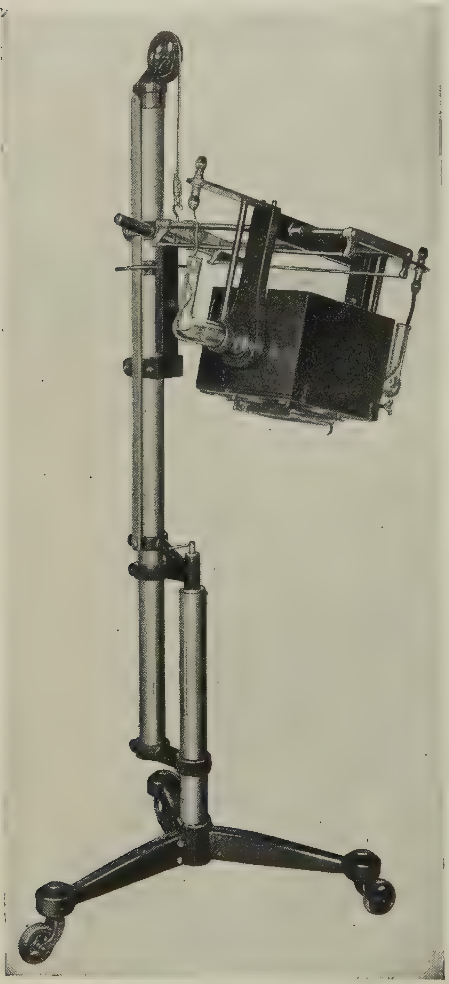

Fig. 62.—MacKee treatment tube-stand.

The tube should be placed in a protective lead-lined box covered with wood, or a metal housing which is grounded. In this there is an opening of adjustable dimensions for the exit of the therapeutic beam of x-rays which is focused upon the patient, and for necessary ventilation to keep the tube cool. Placing of the tube in a lead-lined box sometimes gives a false sense of security, because primary rays emitted set up a very appreciable amount of secondary radiation. The parts of the patient that are not to be exposed to the x-rays are screened from them by sheet-lead 1/16 inch thick,[1] or lead-rubber $\frac{1}{8}$ or $\frac{1}{4}$ inch thick, which were previously mentioned. As lead-rubber is expensive it is employed only for shielding large areas, being cut in convenient strips (1 by $1\frac{1}{2}$ feet), which are used over and over. When small lesions are treated, holes for exposure can be cut in the sheet-lead, which is less expensive, and a small piece of this used around the lesion, the pieces of lead-rubber being then laid overlapping the margins of the sheet-lead. In this way the pieces of lead-rubber can be used repeatedly without cutting them, and a small fresh piece of sheet-lead can be cut each time to fit any small lesion under treatment.

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[1] Protection is also discussed on pages 114 and 137. More detailed discussions may be found in Kaye, G. W. C.: The Fundamental Aspects of Roentgen Rays and the Protection of the Roentgen-ray Worker, Am. J. Roentgenol., 18: 401–425, Nov., 1927, and Circular of the Bureau of Standards, No. 374, and the rules adopted at the Second International Congress of Radiology in Stockholm, July, 1928, reprinted in the J. A. M. A., 92: 1428–1429, April 27, 1929.

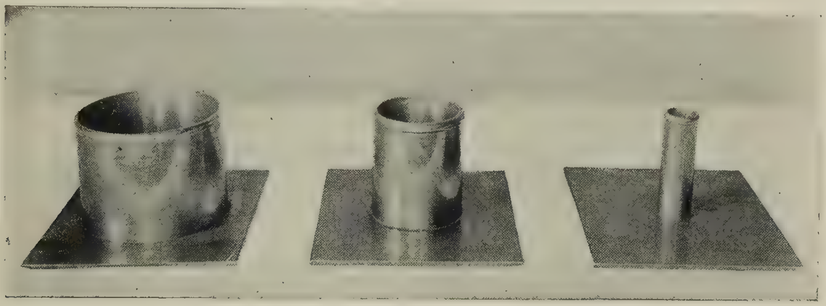

Fig. 63.—Treatment cones of various sizes.

It is an important rule to have the terminals of the tube always at a greater distance from the patient than the length of the spark gap. The tube should never be tested after it is adjusted over the patient. Any testing should be finished before the patient is admitted to the room. The operator should never leave the room while the motor is running even though the x-ray switch is out, because the patient is not cognizant of the fact that there is no production of x-rays. Failure to have the wires tight which lead from the aerials to the tube may cause a spark. A single spark is not likely to be dangerous, but it is a warning. The table should be insulated and in other respects the insulation should conform to the requirements of electric safety.

Practical Distribution of Radiation.—The distribution of the radiation is influenced not alone by the location of the disease, but by its extent and the proximity of parts easily damaged by the exposure.

(*a*) *Generalized Dermatoses.*—In widespread and generalized dermatoses, the body surface is divided into areas to be treated at different sittings[2]; the head, face, and upper extremities one day, the trunk two days later, and the lower extremities after another interval of two days. The entire body of the patient is thus treated in all affected areas in the course of a week, while no area is treated more than once a week. If the patient cannot endure so much treatment, it is then advisable to divide the body surface into more areas.

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[1] A material made of a mixture of 1 part paraffin and 5 parts lead oxide applied about the cutaneous lesion in 4.3 mm. layer has been found to afford the same protection to the skin as 1 mm. of lead plate. It can be readily sterilized, is plastic at body temperature and easily applied. Arnell, S.: A Plastic Means of Protection During Roentgen-ray Treatment, Acta Radiol., 3: 66, April, 1924.

[2] Wise, F.: Roentgen-ray Treatment of Widespread and Generalized Diseases of the Skin, J. A. M. A., 73: 1491, Nov. 15, 1919.

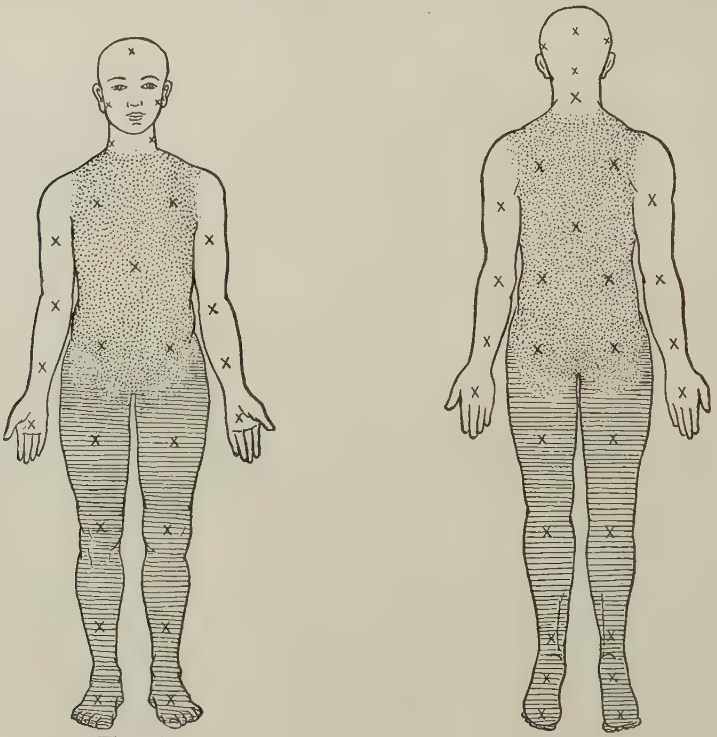

Fig. 64. Fig. 65.

Figs. 64, 65.—Divisions of body surface and focus points in generalized eruptions.

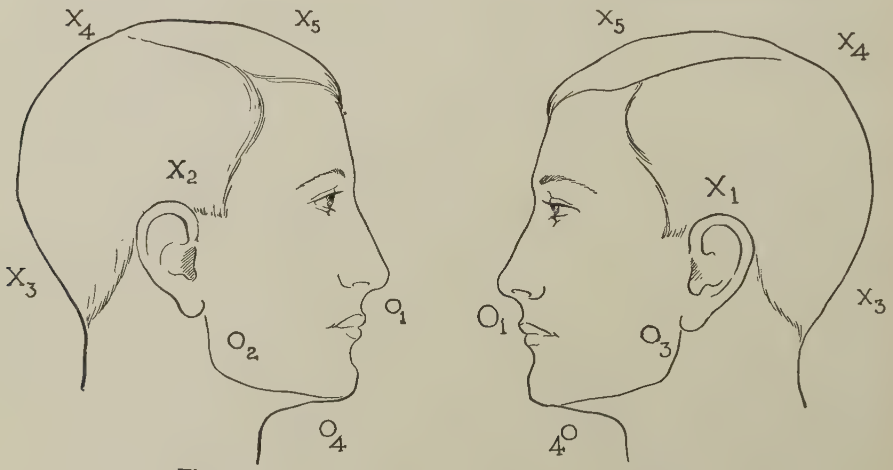

Fig. 66. Fig. 67.

Figs. 66, 67.—Usual focus points on the face and scalp.

Schedule for treatment for three times a week, the body being divided into three areas:

1. *Head.*—Divide into five areas—frontal, vertex, occipital, two parietal —as in tinea capitis. When the face is involved, it should be left uncovered during these exposures. If not involved, it should be protected, as described under the technic for tinea capitis.

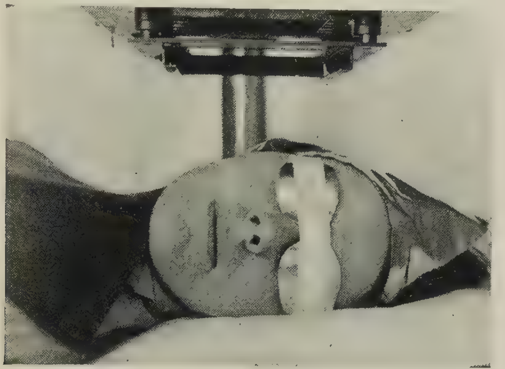

Fig. 68.—Technic for treatment of the side of the face.

Arms.—Divide into six areas, three anterior and three posterior. If the hands are involved, use hand in one of the areas. Anteriorly—biceps, bend of elbow, wrist; posteriorly—upper part of triceps, elbow, and wrist.

2. *Trunk.*—Divide into eight areas, four anteriorly, four posteriorly. Anteriorly—two on chest, focusing above and to outer side of nipple, and two on abdomen; posteriorly—on the outer side of each scapula and each loin. Buttocks, two areas.

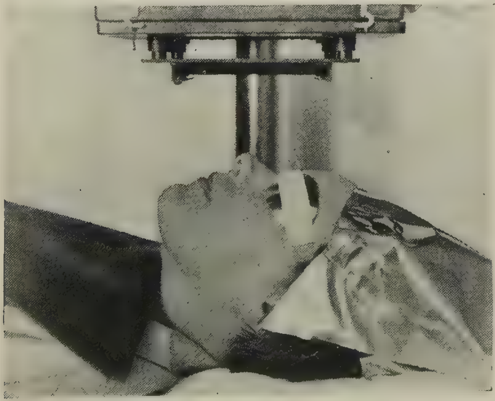

Fig. 69.—Exposure of the midface.

3. *Legs.*—Divide into six areas. Anteriorly—groin, knee, above ankle; posteriorly—below buttocks, popliteal space, ankle. Feet—dorsum and sole.

Ordinarily in fractional treatment there is sufficient overlapping to equalize the distribution of dosage upon the lateral surfaces, but occasionally in large individuals accessory exposures to the lateral aspects of the thighs and trunk are necessary.

(b) *Special Regions.*—The exposure of special areas requires detailed technic. Some operators treat patients in the sitting position for exposures to the *face* but treatment in this manner is likely to be inaccurate unless the tube-stand is especially designed for such technic. In cases where the face or back of the neck is exposed, the eyebrows and hairy scalp should be shielded and proper screens placed over the thyroid and chest. The latter is most

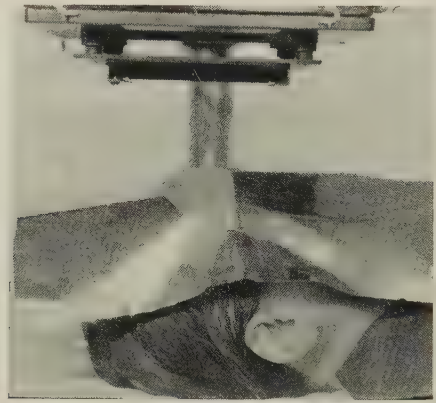

Fig. 70.—Treatment localized to forehead.

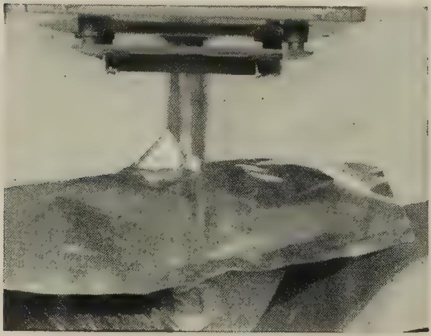

Fig. 71.—Exposure limited to upper lip.

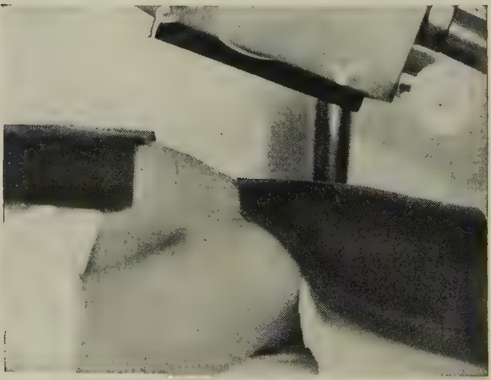

Fig. 72.—Exposure of the upper chest.

important as it not only protects the organs from unnecessary irradiation, but also prevents superimposition of treatment upon the skin of the chest, which often results in telangiectasis if this precaution is neglected. The *eyes* should be protected by spectacles cut out of sheet-lead and affixed with ad-

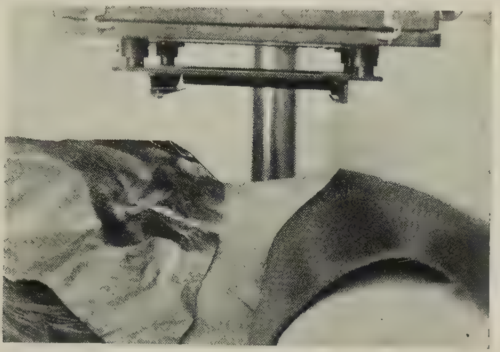

Fig. 73.—Exposure of the back of the neck.

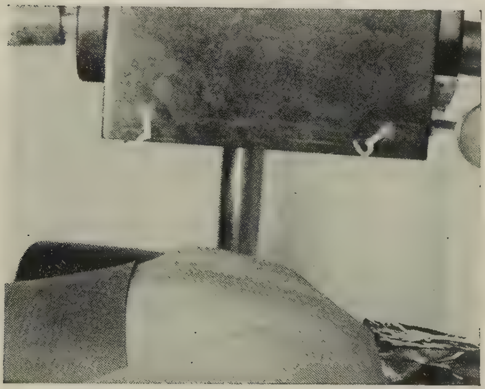

Fig. 74.—Exposure of the right scapular region.

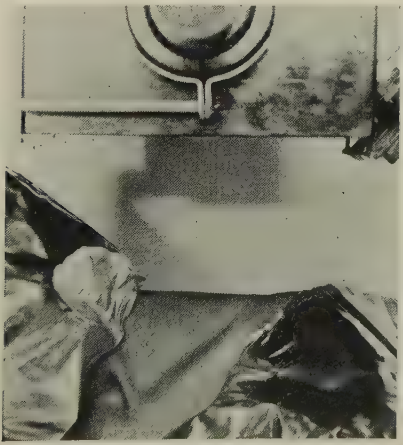

Fig. 75.—Exposure of the shoulder. Patient in a sitting position with head bent laterally.

hesive tape. When the lesions are located near the eyes, it is often possible to increase their distance from the eyes by pulling the affected tissue downward with adhesive tape. When the *ears* are treated they should be exposed separately from the rest of the face. This is accomplished by shielding them with a sheet of lead during exposures to the face and giving each ear a separate application through an opening of proper size. When the lesions are behind

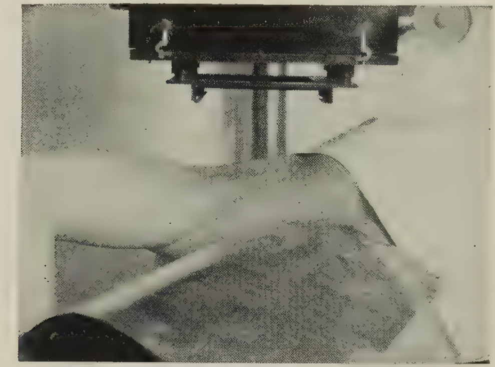

Fig. 76.—Treatment of left axilla. Patient recumbent.

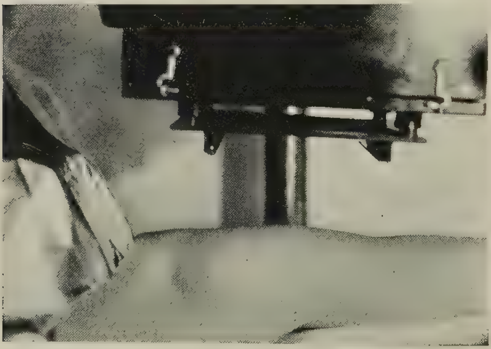

Fig. 77.—Treatment of upper arm. Patient sitting with arm outstretched on table.

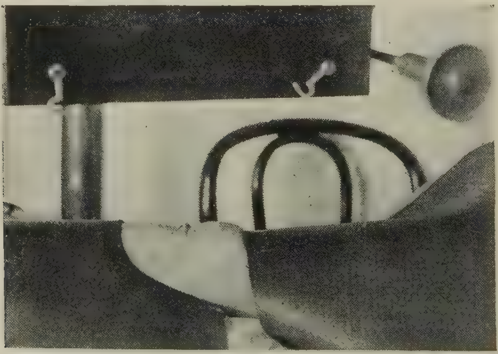

Fig. 78.—Exposure of back of elbow. Patient sitting, leaning forward with affected arm pronated and laid upon table.

the auricle this appendage should be held forward by strapping with adhesive tape. For treatment of the *submental region,* a pillow should be placed under the shoulders and the head retroflexed as far as possible as so to make the region upon a plane level with the chest. This technic is also used in exposures to the upper *lip* and *nostrils.*

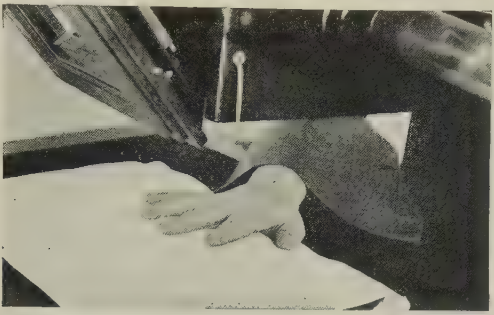

Fig. 79.—Exposure of back of hand. The surface should be kept flat.

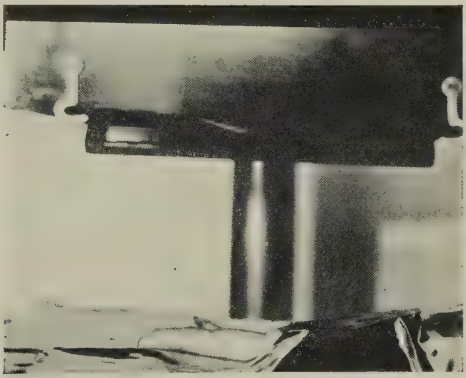

Fig. 80.—A finger is exposed through a hole in a piece of sheet-lead.

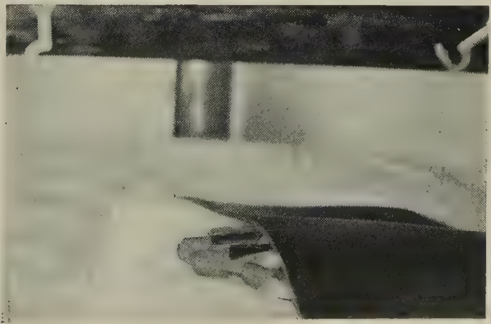

Fig. 81.—To treat the fingernails the hand is placed upon a sand bag and the proximal parts of the fingers are protected separately by small pieces of sheet-lead, the back of the hand being covered by sheet-rubber.

For exposure to an *axilla* the patient is best placed upon his opposite side with the arm of the affected side raised over his head. The *forearms,* *elbows,* and *upper arms* are treated by placing them upon the table, one arm at a time, with the patient seated sidewise. The *hands* and forearms are treated similarly, with the patient facing the table. To insure steadiness and a flat surface it is desirable to place a book beneath the hand. To attempt to treat both hands or both forearms with the same exposure is inaccurate technic, as each should be irradiated separately. The *fingers* are separated a little to expose the interdigital spaces. The *fingernails* should be treated in a manner similar to the treatment of the hands, with careful shielding of the proximal phalanges.

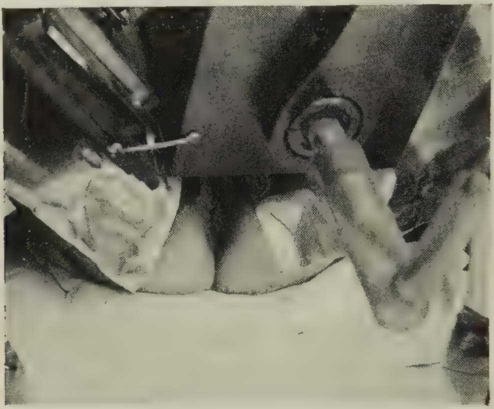

Fig. 82.—To expose the vulva the hips are well elevated on sand bags, and the inner thighs are protected by sheet-lead. The patient's hands must not be used to facilitate the exposure in any way.

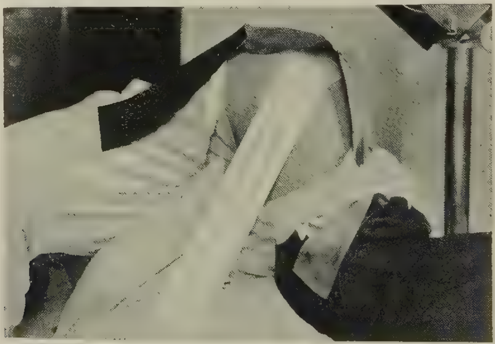

Fig. 83.—In the treatment of pruritus ani the knee-chest position is usually best. The buttocks are held apart by broad strips of adhesive tape stretching from the perianal region to the sides of the table. The buttocks are protected by sheet-lead in which an aperture is cut.

The *genitals* require special shielding at all times. This is best accomplished by a sheet of lead-rubber 12 inches wide and 18 inches long. In treating the vulva,[1] it is advisable to place a pillow under the hips to elevate them. Care should be exercised to protect the inner thighs by shielding from over-irradiation, and the distance from the inner thigh to the tube should be no less than from the vulva to the tube. In the treatment of the scrotum the testicles should be held out of the field of exposure by the patient's hand, which should also be carefully protected from the radiation. The penis may be irradiated by placing it through a hole of sheet-lead with extra protection of the testicles.

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[1] See also pages 369 and 410.

To radiate the *gluteal crease* the patient lies on the abdomen. The buttocks are separated by two pieces of wide adhesive tape, the distal ends of which are affixed to the table. In the treatment of the *perineum* or *anal regions* the knee-chest position, the prone position, or the lithotomy position may be used. The best posture should be selected after the patient has been tried in these positions. An oblong opening the size of the affected area is made in a piece of sheet-lead. The genitals should always be shielded during such exposures.

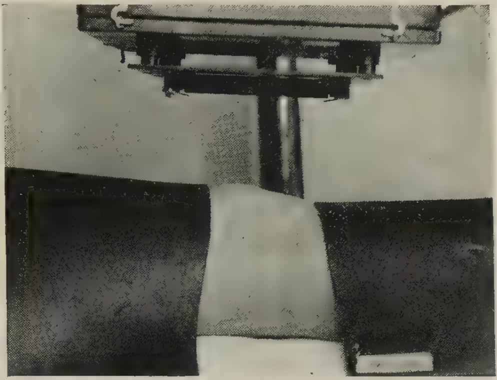

Fig. 84.—Exposure of the knee, which rests upon a sand bag.

The *groins* are exposed with the patient lying on the back, with the genitals properly shielded. For the treatment of the *inner thighs*, the patient should lie on his side with the affected extremity flexed at the hip and at the knee, and the other extremity fully extended. The *feet* are exposed separately. When treatment is given to the dorsum of the foot, it is advisable to place the toes on a book, so that the dorsal part is made as level a surface as possible. For the treatment of the sole, the patient should lie in a prone position

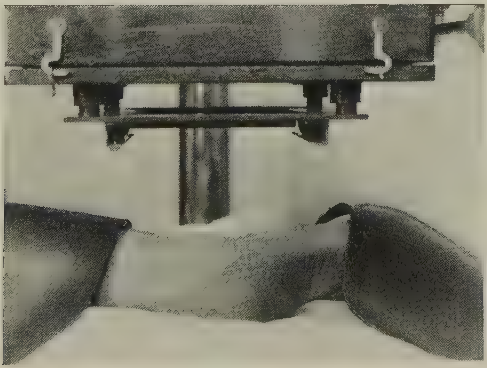

Fig. 85.—Exposure of the side of the ankle. Note heel resting upon a sand bag and the careful protection of the toes.

with the foot placed on a small stool. The operator should take care to have the sole a level surface; and when the feet are large and diffusely involved the sole should be divided into two areas, the ball being treated separately from the heel. For affections between the *toes* similar postures are used. Small corks are frequently helpful in keeping the toes apart so that the interdigital spaces are exposed.

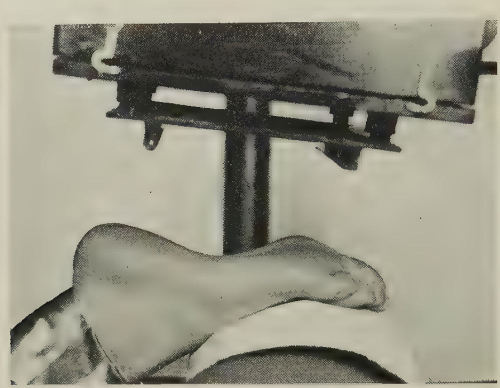

Fig. 86.—To expose the sole the patient lies prone. The knee is flexed, the foot resting upon a low stool. It is frequently desirable to divide the sole into two areas and to treat the ball and the heel separately, shielding each.

Special technic is required for certain diseases which is described in the following chapters under the proper captions.

Static Electricity.—Occasionally during treatment static electricity accumulates in the sheet-lead and induces burning, stinging, or pricking sensations in the skin under the lead. They may be severe enough to cause considerable discomfort to or fear in adults, and in children may prevent the continuance of treatment. Often these sensations are the sole cause of the child's crying and fear of the x-rays. Such irritation of the skin occasionally causes a subsequent hyperemia which may appear immediately or two or three days after the exposure and be mistaken for an x-ray erythema or burn. These hyperemias disappear two or three days after onset and may be followed by

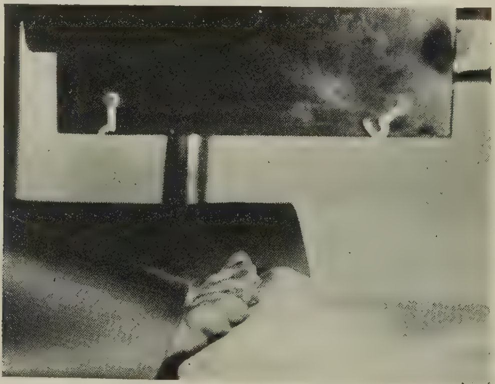

Fig. 87.—To expose the toes the patient sits upon the table and the toes are placed upon a sand bag.

hyperpigmentation. They are to be differentiated from x-ray burns by their rapid onset, location, and evanescence. Static hyperemias can usually be prevented without grounding by restricting the use of sheet-lead to a small fresh unwrinkled piece supplemented by lead-rubber, which does not produce static, or by the insertion of chamois or towels between the sheet-lead and the skin, or by placing the patient's hand in contact with the sheet-lead in a place well outside the field of exposure.

GENERAL CONSIDERATIONS

Although there is much discussion of the biological action of roentgen rays and radium, little, if anything, has been actually proved. Investigations have given varied results, about the interpretation of which there are conflicting opinions. That practically all portions of the living body are influenced by radiant energy is recognized.[1]

Elective Action.—The biological effects[2] of radium and x-rays are not distinguished by any specific characteristics. The intensity and the concentration of the energy largely determine the character of their action. The elective biologic action and the penetrating power are two properties of radiation which are closely allied.

The different cellular elements present an unequal sensibility to the action of the same dose of radiation. One designates as "elective action" this power of x-rays and the rays of radium to act upon certain cells, while having no apparent action upon adjacent cells. This is true of the different organs considered as a whole and of particular groups of cells in each organ. Radiosensitivity, however, does not depend upon the anatomical position of the cells.

Inhibition, Destruction, and Stimulation.—The principal biological effect of radiation is an inhibition of functional activity and growth. That small doses may temporarily stimulate is contended by some and disputed by others, the latter holding that there is no primary stimulation in the sense of increased activity. Apparent stimulation may be due to the destruction of certain sensitive cells, which permits increased growth of less sensitive ones. In varying doses roentgen rays either stimulate, inhibit or destroy the reproductive activity of cells. This is particularly true of embryonic cells (which may be influenced to develop into abnormal adult forms), reproductive cells, secretory cells, and certain groups of abnormal cells, whether inflammatory or neoplastic. The intensity of radiation for graded effects on cell functioning, not peculiar to x-rays, varies with the sensitiveness of the cells and tissues, those with coarser function requiring larger doses, and the most delicate functions being affected first. Inhibitory action tends to lower cell function, retard growth, and cause injury and death. This action on cells varies in different stages of health and disease, youth, and age.

Latent Period.—A certain interval elapses between exposure to radiation and apparent biological changes. This interval is called the latent period. It is not particularly characteristic of tissues exposed to radiation, being in fact rather a general biological phenomenon with many analogies in the reactions of tissues to external irritants.

The duration of this period depends upon the nature of the radiation, the dose employed, the organ radiated, and also divers biological factors, among which cellular activity holds the most important place.[3] The manifestation of the destructive action is early, in accordance with the rapidity with which the cell accomplishes the cycle of its existence. The latent period varies inversely with the intensity of radiation and with the radiosensitivity of different types of cells (short in leukocytes, long in epithelial cells of the skin). It is thus that the radiation of certain extremely sensitive tumors, as the lymphocytomas, for example, is accompanied by considerable objective changes from the beginning of treatment, whereas other tissues such as the skin are tardy to manifest any alterations; that is to say, the duration of the period of latency depends upon the histological constitution of the tissue considered —of the relative amount of radiosensitive elements in it. The radiosensitivity and the duration of the latent period after radiotherapy are, nevertheless, two different and independent phenomena.

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[1] Kuhlmann, B.: The General Action of Roentgen Rays, Strahlentherapie, 19: 817–881, 1925; Ab. Am. J. Roentgenol., 15: 285, 1926.

[2] Holthusen, H.: The Biological Aspects of Roentgen Therapy, Radiol., 12: 35–44, Jan., 1929.

[3] Laborde, S.: Conception of Radiosensibility of Tissues, J. de Radiol. et d'Electrol., 8 : 289–306, July, 1924.

Effects of Wavelength.—There are no well-defined differences in the biological and therapeutic effects of electromagnetic waves within the *x*-ray spectrum, regardless of the diversity of their lengths.[1] The atomic weights of the elements of which tissues are composed are so small that any elective absorption would be expected only in *x*-rays of longer wavelengths than ordinarily used in therapy. In practice certain clinical differences are noted. The soft rays produce caustic and destructive effects, whereas very hard rays have more selective action. The range of *x*-rays, however, is so small that such differences in clinical action are not important and are only seen in the use of radium. *x*-Rays have not as yet been developed of sufficient hardness to give the selective biological effect derived from gamma radiation. Roentgen rays of different wavelengths have, therefore, similar therapeutic effects, the quantity or *x*-ray energy absorbed by the lesion being the major consideration. As the amount of absorption at various tissue strata depends upon the range of penetration of the incident beam, quality influences the biological response. The greatest absorption should be concentrated at the depth of the disease process. We must accept as a principle that the biological effect coincides approximately with the quantity of *x*-ray energy which is absorbed by the treated lesion.

As the primary beam is of exceedingly heterogeneous constituents, some being of long wavelengths (soft, nonpenetrating), and others of short wavelengths (hard, penetrating), it is possible, in the treatment of thick or deep lesions, for some of the *x*-rays not to penetrate the lesion or to go entirely through it, with very little absorption of their energy. Filtration offers us the means of separating the softer components so readily absorbed by the surface layers and so liable to produce burns from the primary heterogeneous beam to a degree dependent upon the density and thickness of the material used as a filter. There is no foundation for the opinion that in certain skin

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[1] "This assumption is made still more plausible by the following considerations:

"The transformation of the energy does not take place instantaneously, but in stages. A part of the primary energy is scattered. According to recent measurements made by A. H. Compton, the wavelength of the scattered radiation is somewhat longer than that of the incident radiation. Furthermore, a large part of the primary and also of the scattered radiation is transformed into characteristic radiation, which is independent of the wavelength of the exciting radiation and depends only on the composition of the tissues in which it is excited. Finally, each one of these radiations causes electron emission (secondary beta rays). The velocity and the range of the emitted electrons depend on the wavelength of the exciting radiation. While the velocity and the range increase as the hardness of the primary radiation is increased, it must be noted that through the medium of the characteristic radiation a partial equalization takes place. The transformation of the energy of the rays into electronic energy also takes place in steps. The electrons, moreover, lose their velocity by successive collision and at each impact produce dissociation. The latter, therefore, cannot vary a great deal with rays of different wavelength. We may even go farther and say that there cannot be any fundamental difference between corpuscular and wave motion as regards biological effect, since the wave motion acts only indirectly through the medium of secondary corpuscular radiation.

"We are led to assume, therefore, that roentgen rays of different wavelength, gamma rays, and corpuscular beta rays produce very similar effects on the cells from the standpoint of physics. Accordingly we may expect similar, if not exactly the same, biological effects." Bachem, Albert: Radium and Roentgen Rays as Different Agents in Superficial and Deep Therapy, Am. J. Roentgenol., 11: 14, Jan., 1924.

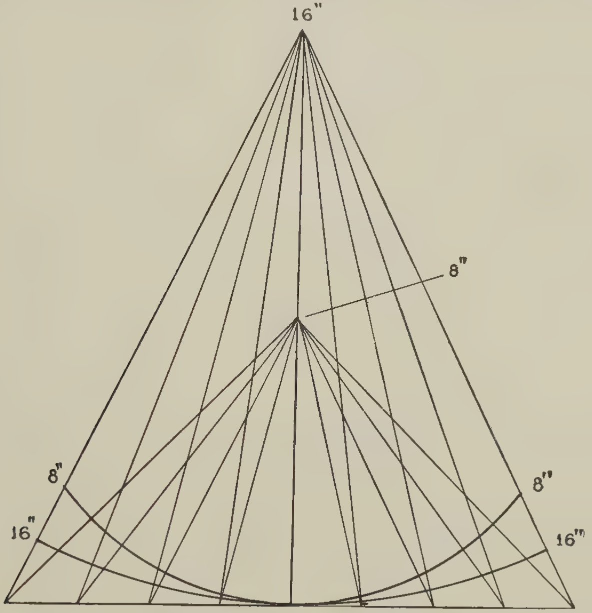

Fig. 88.—Diagram showing the spread of the radiation beam at anode-skin distances of 8 and 16 inches. It illustrates the change of intensity as the sine of the angle of incidence and inversely as the square of the distance, and the degree of concavity, which equalizes the intensity upon extensive surfaces.

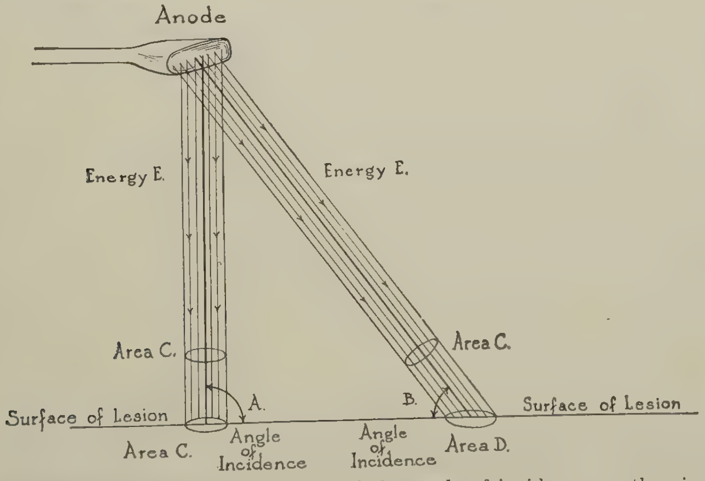

Fig. 89.—Diagrammatic illustration of effect of the angle of incidence on the size of the area over which the radiation is distributed.

affections some particular length of roentgen rays is specifically desirable. The effects are independent of wavelength.

In this country most superficial treatment is carried on with unfiltered radiation. In cases which do not respond to unfiltered exposures it is customary to try filtered x-rays later. In a few affections filtered x-rays are indicated from the beginning. They are frequently more beneficial than radiation applied without a filter in lesions which are deep, thick, or indurated.

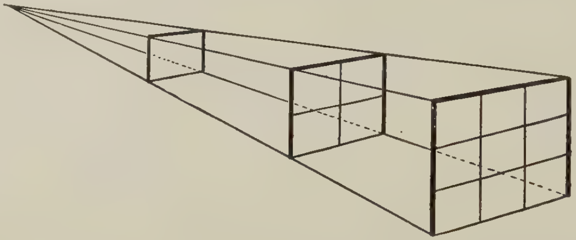

Fig. 90.—Drawing to show the effect of distance upon the intensity. The intensity of radiation from a point source varies inversely as the square of the distance.

Laws Governing Intensity.[1]—Intensity varies directly as the milliamperage and time. It varies inversely as the square of the distance, and directly as the square of the voltage. Intensity varies directly as the sine of the angle of incidence.

Effects of Distance.—Although increase of distance diminishes the intensity in accordance with the inverse square law, it simultaneously augments the surface falling within the direct beam of the x-rays, and increases the sines of the angles of incidence of beams impinging toward the periphery of the area exposed to treatment. This causes a more uniform distribution of the irradiation upon the area treated. The benefits of increase of distance are noticeable in epilation work, or in cases of acne where the lesions are widespread upon the forehead, cheeks, and neck. In the treatment of convex surfaces, such as the legs, the result from increase of anode-skin distance is often beneficial. The augmentation of the irradiation at the periphery of the areas under treatment necessitates proportionate diminution in the amount of overlapping which is permissible with safety. Excessive overlapping may be obviated by careful shielding.

It is important to realize that small errors in the measurement of the anode-skin distance cause relatively large inaccuracies in dosage. For instance, an error of ½ inch in measuring an 8-inch anode-skin distance entails an error of 12½ per cent in the dose. Discrepancies of this kind are much more serious for short than for long anode-skin distances.

Intensity Below the Surface.—From experience with unfiltered x-rays, Stentröm concluded that a radiation dose at 1 cm. depth is between 50 and 60 per cent of a skin dose and at 2 cm. between 25 and 35 per cent. He used a circular field 2 cm. in diameter, no filter, Coolidge tube, 127 kv., 10 ma., 23-cm. anode-skin distance. An erythema produced on the skin was the standard of measurement, and sheets of paraffin were used for absorption and for scattering of the x-rays. The depth dose[2] of more penetrating radiation is naturally greater than of unfiltered radiation. Practically homogeneous distribution to a depth of 1 cm. is obtained by voltages of 150 to 170 kv. through $\frac{1}{4}$ mm. of copper filter.

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[1] These are strictly applicable only within the usual variations of skin therapy.

[2] The depth dose is the intensity per unit area situated at a depth below the surface of the skin in a unit of time.

The intensity below the surface is influenced by many factors, of which the principal ones are loss through increased distance from the source and absorption by the tissues. The loss due to distance conforms more or less with the inverse square law, which, however, only strictly applies to a point source. Tissue absorption varies according to the density of the tissues. The size of the portal of entry, the angle of incidence, the quality of radiation, and the type of filtration also modify the intensity below the surface.

Skin Toleration.—Variations in susceptibility to the roentgen rays are an important factor in the production of sequelae. Patients should be watched closely for detection of the slightest reaction. It is advisable to avoid visible skin reactions when using *x*-rays or radium, unless such reactions are necessary for therapeutic effect, because even a mild reaction may be followed by undesirable results.

Females are more sensitive than males, blondes more than brunettes, and young people more than the aged. Reaction to radiation differs with individuals so that the exposure time necessary to produce an erythema is shorter in some than in the case of patients in general.

Some body areas are more sensitive to radiation than others, depending upon the texture of the skin, the amount of pigmentation, the blood supply, and the amount of subcutaneous tissue. The inner surfaces of the thighs, the axillae, and the flexor surfaces of the forearm are known to be the most sensitive areas due to their fine texture. Parts habitually exposed to sunlight and atmospheric conditions, such as the head and the dorsal surfaces of the hands, have slightly increased tolerance.

Hyperemia, regardless of its cause, increases the sensitiveness of the skin to roentgen therapy. This is noted in the increased blood supply due to flushing, plethora, sunburn, heat, ultraviolet or other radiant erythema, or inflammation from external or internal causes. Although this is true, paucity of blood supply makes large doses hazardous, especially where the subcutaneous tissue is scarce. The skin over the mastoid, the sacral regions, interphalangeal joints, and other bony prominences is intolerant to large doses, particularly in cachectic individuals. Constitutional states, such as diabetes and primary or secondary anemia, cause a lowered tolerance to intensive exposures.

In addition to sex, age, texture of skin, circulation, and particularly location, inaccuracies of the best technic may cause variations in reactions. It is generally admitted that true idiosyncrasy to roentgen rays is of rare, even dubious occurrence. More or less minor variations in susceptibility do exist, principally based upon the above considerations. In view of the work of Duke which directs attention to the fact that there exist patients who are supersensitive to the action of visible light and ultraviolet light, the possibility of isolated instances of individuals who are hypersensitive to the action of ordinarily innocuous doses of roentgen rays is theoretically conceivable. The phenomenon of such allergic reactions to radiant energy may form a basis for further study of cases showing unexpected clinical response to roentgen therapy. Leddy and Weatherwax, from observations made upon a large group of patients, conclude that, regardless of the technic, provided it is kept constant, very little uniformity of reaction among patients is observed.

The routine testing of a patient's skin for toleration may be tried before a course of treatment is begun. An area about an inch square may be used for the test. Although a given dose of x-rays applied to a larger area will cause a very much greater reaction than to a relatively small area, the difference does not seem great enough to negative the value of small areas (four square centimeters) for testing skin toleration. The area should be on some sensitive part of the body surface. This test procedure is so unreliable that it is not in general use or to be recommended.

Drugs.—No strong irritating or metallic local application should be made externally while roentgen rays are being used. Irradiated skin reacts to external irritants more readily than nonirradiated skin. Haxthausen has observed that recurrences in roentgen treated eczemas are often very obstinate and has performed experiments which determine that roentgen irradiated skin reacts in a large number of cases more strongly than normal skin to external irritations, and this takes place even though the roentgen-ray dose is kept within the limits of eczema therapy, and no direct visible changes in the skin are produced. Metallic ointments or lotions covering or infusing the skin may act as a barrier to, or a check upon, the penetration or impingement of radiation. A suberythema dose may be excited into an erythema dose by an application of irritants or metallic substances[1] (resorcin, scarlet R, cantharides, betanaphthol, iodine, chrysarobin, pyrogallic acid, salicylic acid, iodoform, tar, sulphur, arsenic, mercury, *et cetera*). Secondary irradiation from metallic ointments or lotions impregnating the skin occasionally augments, to a considerable extent, the action of the primary roentgen rays. These secondary rays are very soft, intense, and easily absorbed by the skin and, according to Reed, frequently account for patches of lupus breaking down because of the prolonged application of metallic ointment previously made and the secondary radiations thus incited.

The action of local irritating or metallic applications and radiation is reciprocal. When one has had considerable experience it is safe to combine the two treatments cautiously if moderation is exercised. Often this combined treatment gives far better therapeutic results than can be obtained by either measure used alone. Reed has observed that a small patch of lupus into which zinc ointment has been rubbed before irradiation, responds and heals more quickly than one treated without the ointment, and he believes it is because of the secondary rays. After experience the radiologist is warranted in using fractional therapy together with weak local applications, such as a lotio alba or weak ointments containing sulphur, mercury or salicylic acid. The stronger the local remedy, the smaller must be the amount of radiation, and *vice versa*.

Some of the drugs that can be used with safety are:

phenol, 2–4 per cent
calamine
ichthyol, 1–3 per cent
magnesium carbonate
boric acid
vaselin
lanolin
alcohol
witch hazel
bay rum

Contraindications.—There are certain conditions contraindicating x-ray treatment which must be guarded against, such as: (1) grave blood affections and diseases of the blood vessel walls; (2) local irritations—acute inflammatory or hemorrhagic diseases of the skin, or inflammations due to irritating topical remedies; (3) previous overirradiation, and (4) recent radiotherapy or radiography.

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[1] Crutchfield, E. D.: Use and Abuse of x-Rays in the Treatment of Common Skin Diseases, New Orleans M. and S. J., 77: 259–263, Jan., 1925.

When exudation and considerable moisture are present Crutchfield found roentgen rays of little use. In the author's opinion this is true of bullous diseases, but many vesicular, exudative, and moist dermatoses have given the most spectacular results to fractional roentgenization.

Indications.—The indications for x-ray treatment are symptomatic or structural. Roentgen rays are used at times rather empirically; but there is usually a conception of the underlying reason based upon clinical or histopathologic grounds. They are predominantly *inhibitory*, and are therefore used mainly upon anaplasias, hyperplasias, and hypertrophies, and seldom upon atrophies and dystrophies. Their pronounced effects upon *immature and rapidly growing tissues* are a basis for their use in many simple inflammatory, granulomatous, and neoplastic infiltrations. Diseases dependent upon *functional or productive overactivity*, such as acne and hyperidrosis, are favorably influenced by x-rays. Their *keratolytic, antipruritic, and depilatory* properties afford definite indications in verrucous, hyperkeratotic, and pruritic diseases, and in those requiring epilation.

With these points in mind we see, in a general way, that x-ray therapy is indicated in itching, lichenification, infiltrations, thickenings, indurations, new growths, and diseases requiring depilation or inhibition of glandular activity.

Radiation by x-rays or radium is forcefully *indicated* in:

acanthosis nigricans
actinomycosis
angioma
blastomycosis
bromidrosis
clavus
cornu cutaneum
dermatitis papillaris capillitii
epithelioma
favus of the scalp
hyperidrosis
hyperkeratosis of palms and soles
keloid
keratosis follicularis
leukemia cutis
lichen chronicus (Vidal)
mycosis fungoides
rhinoscleroma
sarcoid
sarcoma
scrofuloderma
sycosis vulgaris
trichophytosis capitis
trichophytosis profunda
tuberculosis orificialis
verruca vulgaris et plantaris

Radiation is also *useful* in:

acne vulgaris
carbunculosis
chancroid
condylomata acuminata
dermatitis seborrhoeica
dermatitis exfoliativa
dermatitis herpetiformis
dermatitis venenata
eczema
erysipelas
erythema induratum
folliculitis
furunculosis
hypertrichosis
impetigo
lepra nodosa
lichen planus
lichen scrofulosorum
lupus vulgaris
neurofibroma
papillomata
paronychia
pernio
phlegmon
pityriasis rosea
prurigo
pruritus, localized or general
psoriasis
rosacea
rhinophyma
sporotrichosis
tuberculide
tuberculosis verrucosa cutis
verruca plana

These various skin diseases may be grouped to clarify, in general, the degrees to which radiation is of value in the treatment of each[1]:

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[1] MacKee, G. M., and Andrews, G. C.: Value of x-Ray Therapy in Dermatology, Am. J. Roentgenol., 9: 241–246, April, 1922.

I. Diseases in which radiation offers the *only means* to a permanent cure with a reasonable degree of certainty:

bromidrosis, localized
dermatitis papillaris capillitii
hyperidrosis, localized
keloid
rhinoscleroma

II. Diseases in which radiation is the *most useful* treatment. seldom, however, with permanent relief:

Hodgkin's disease of the skin
leukemia cutis
lymphogranulomatosis cutis
mycosis fungoides
sarcoma (giant cell, Kaposi type)

III. Diseases *usually permanently cured* by radiation. These affections can be more or less successfully treated by other methods, but radiation therapy is most likely to bring prompt relief:

actinomycosis
angioma (cavernous, senile, strawberry mark)
blastomycosis
callositas
favus of scalp
furunculosis, localized
granuloma annulare
lupoid sycosis
lupus miliaris disseminatus
pruritus
scrofuloderma
sycosis vulgaris
synovial lesions of the skin
tinea barbae
trichophytosis capitis

IV. Diseases in which radiation alone produces *more or less benefit.* To obtain the best results the cases must be selected, and radiation must frequently be combined with surgical or other methods of treatment:

carbunculosis
epithelioma
erythema induratum
keratosis
leukoplakia
lupus vulgaris
mal perforans
neurofibroma
Paget's disease
sarcoid
sarcoma
tuberculosis orificialis
tuberculosis verrucosa cutis
xeroderma pigmentosum

V. Diseases in which radiation or other dermatological treatment can be *beneficially applied;* radiation, however, giving the best comparative results:

acne varioliformis
acne vulgaris
cheilitis exfoliativa
cheilitis glandularis
clavus
dermatitis exfoliativa
dermatitis herpetiformis
dermatitis seborrhoeica
eczema
eczematized ringworm
folliculitis decalvans
infectious eczematoid dermatitis
intertrigo
lichen simplex (Vidal)
lichen planus
lymphangioma circumscriptum
onychia
paronychia
pityriasis rosea
pompholyx
prurigo
psoriasis
tuberculide
verruca vulgaris et plantaris

VI. Diseases in which radiation is *beneficial*, but generally other forms of treatment produce better results:

adenoma sebaceum
hypertrichosis
leukoplakia
pigmented and hairy nevi
rhinophyma
rosacea
sebaceous cyst
sporotrichosis

VII. Diseases in which radiation has been successfully applied but a sufficient number of cases have not been treated to determine its exact value:

acanthosis nigricans
chronic streptococcic lymphangitis or persistent lymphedema
granulosis rubra nasi
herpes recurrens
keratosis follicularis
kraurosis vulvae
lichen scrofulosorum
multiple benign epithelioma
parapsoriasis
pernio
syringoma

VIII. Diseases in which radium is preferable to roentgen-ray treatment, although either agent may be used successfully.

angioma
clavus (soft)
epithelioma
keratosis
kraurosis vulvae
leukoplakia
lupus erythematosus
lymphangioma
verruca vulgaris et plantaris

General Precautions.—It is advisable for the beginner not to attempt experiments with various milliamperages, distances, and filters, but to use consistently a uniform set of factors for treatments. In this way many miscalculations and accidents can be avoided. The most serious omission is to forget to insert a filter.

In generalized and widespread dermatoses, when it is necessary to apply radiation to the entire body, systemic reactions consisting of syncope, nausea, vomiting, malaise, pyrexia, prostration, and leukopenia, may result from excessive irradiation given at one sitting. Such cases should, therefore, be treated serially on alternate days, with small doses, as described on pages 119 and 120.

To find and control the factors which produce systemic reactions is difficult. Gas-poisoning in the *x*-ray room, high induced voltage of the patient, and psychical causes, as well as toxemia from temporary functional depression of the kidneys or inorganic disturbances from acidosis are considered likely factors in producing biochemical changes incident to "radiation sickness." Observations[1] made according to the site of radiation—(1) abdominal, (2) cervical, (3) thoracic, (4) and any other part—were similar with *x*-rays or gamma rays. Some cases treated with calcium chloride or sodium bicarbonate before exposure showed less reaction following radiation. Müller ascribes the disturbing effect likely to follow roentgen treatment to an actual protein shock action. Cells devitalized by rays exert a shock action like that of parenteral protein therapy. "The chief requisites are accuracy of technic and a knowledge of the relationship existing between a given dose and its biological effects."

The general dangers which should be guarded against in the use of roentgen rays may be stated briefly:

1. *x*-Ray dermatitis or burns may occur either in the operator or the patient.
2. Severe *x*-ray burns in the case of the operator with subsequent exposure to repeated doses of *x*-ray are likely to produce malignant neoplasms.
3. In conjunction with radiodermatitis, conjunctivitis, and brittleness, deformity and loss of the fingernails may occur.

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[1] Dodds, E. C., and Webster, J. H. D.: Metabolic Changes Associated with *x*-Ray and Radium Treatment, Lancet, 1: 533–536, March 15, 1924; also in Brit. J. Radiol., 29: 140–149, April, 1924.

4. Alopecia may be the result of overexposure to x-rays, and may occur following a single overexposure of the scalp, usually in the course of epilation in cases of ringworm.

5. As the genital cells are highly susceptible to the action of x-rays, sterility has often resulted, due to inadequate protection.

6. The intestinal mucosa is particularly sensitive to radiations.

7. Extensive blood changes are known to have resulted from prolonged exposure to radiations. Blood counts (routine) upon all workers in such departments might advisedly be made as a precaution.

8. Undoubtedly exposure to x-rays has a general depressing effect, producing a marked sense of languor. "Free ventilation, plenty of time off duty, and open-air exercise are essential for all workers" in a department where x-rays or radium are being used.

It is extremely important that for dermatoses, which are not neoplastic, tuberculous or of a very serious nature, the exposures should always be kept below the quantity which will produce an erythema. The beginner in dermatology should keep in mind that severe sequelae may, and generally do, follow the application of over $1\frac{1}{4}$ E. D. of roentgen-ray dosage to any one area of skin within a month. Even a mild erythema which is scarcely visible may be followed by telangiectasis in twelve or eighteen months, and it is barely possible that some atrophy and telangiectasis may supervene even without a preceding erythema. The dangers of an overdose to the skin producing sequelae of one form or another followed by necrosis with sloughing and failure to heal cannot be sufficiently emphasized. The important sequelae that may follow the production of an erythema are: atrophy, telangiectasis, permanent alopecia, scarring, tanning, freckling, keratoses, and later epithelioma.[1] Pigmentation alone is not regarded as injurious, but an erythema should be avoided except in neoplasms or granulomas.

A suberythema dose may be excited into an erythema dose by the application of irritants or metallic substances, or by the accumulation of repeated doses without sufficient intervals. Consequently, it is necessary before any skin treatment by radiation to inquire whether such applications have been made within a month previously and to control local medicinal applications during and for several weeks after treatment.

DOSAGE

The problem of dosage is extremely complicated and up to the present time is by no means solved. Measurement is concerned with that part of the incident radiation which is actually delivered to the site of the disease, either upon the skin surface or at a depth beneath the skin. In the main, it depends upon two factors: (1) Concentration of the radiation, and (2) intensity.

The concentration at the site of the disease is governed by the penetration, which in turn depends upon the quality. It would seem that eventually we must include wavelengths as well as quantity output in our expression of dosage, because for any particular depth the latter is dependent upon the penetrative value of the incident beam which determines the strata at which the energy is mainly concentrated. Meyer and Glasser have drawn a curve based upon a series of experiments correlating the erythema dose in radiation units with various x-ray qualities.

[1] Crutchfield, E. D.: Use and Abuse of x-Rays in the Treatment of Common Skin Diseases, New Orleans M. and S. J., 77 : 259–263, Jan., 1925.

Quality.—This is expressed in terms of the penetration or wavelength of the radiation. While all x-ray beams are heterogeneous, they tend to become less so as the voltage is raised and filtration is increased. With heterogeneous wavelengths the absorption coefficient is an average of the absorption of all units in the mixture, but such a measurement is of no real value in the estimation of concentration. The adoption of a single method of determining and expressing the quality is of great importance. The principal methods in use for measuring the quality of a beam of x-rays are the half-value layer and spectroscopy, although there are several others.

The *half-value layer* is based upon the thickness of a certain material which will absorb exactly 50 per cent of the radiation passing through it. Aluminum and copper are most employed for this purpose. Meyer and Braestrup[1] have recommended the determination of the half-value layer in aluminum as the best measure of roentgen-ray quality.

"The advantages of using the half-value layer in aluminum as a quality measure appear to be:

"1. The thickness of the absorbing medium is quite proportional to the quality.

"2. But a single absorbing medium is applied throughout the full range of wavelengths.

"3. Simplicity of statement, with a single unit standard, avoiding transposition.

"4. The method is reasonably simple of application and appears to afford the greatest accuracy over the widest range."

The half-value layers may be changed into effective wavelength values in order to make comparisons with other data found in the literature. All of these terms for the radiation quality are satisfactory only if sufficient filtration is used to make the roentgen-ray beam practically homogeneous. None of the absorption measurements is entirely satisfactory for unfiltered heterogeneous bundles.[2]

Spectroscopy is as yet too complicated for general employment in dermatological practice. By its use one defines the quality of the radiation by a statement of its wavelengths derived from a study of its spectrum by photographic or ionization methods. The spectrum is made by utilizing the reflection of x-rays by crystals. A crystal of known grating-constant is necessary, and by its use measurement is made of the glancing angle of incidence with the atomic planes of the crystal. The angle depends upon the distances between the atomic planes and upon the wavelength of the incident radiation, the angle of incidence equaling the angle of reflection.

The spectra emitted by roentgen rays may be classified into two different types: a continuous spectrum corresponding to the white light spectrum in visible light, and a discontinuous spectrum consisting of a series of lines characteristic of the elements in the target.

Spectral curves have another value in that the areas of the curves are a measure of x-ray output. For example, using them as a basis and ignoring characteristic radiations, we find the x-ray output is proportional to the square of the exciting voltage.

Other methods of measuring quality are as follows:

1. The *absorption coefficient* is closely related to the half-value layer. In the measurement the effects of both absorption and scattering are involved. Between the half-value layer and the absorption coefficient there exists a definite relation.

2. The *effective wavelength* is a practical expression of the quality by comparing the

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[1] Meyer, W. H., and Braestrup, C. B.: Quality Determination of the Roentgen Rays, Radiol., 11: 72–77, July, 1928.

[2] Glasser, O., and Portmann, U. V.: The Standardization of the Roentgen Ray Dose, Am. J. Roentgenol., 19: 56, Jan., 1928.

absorption of the heterogeneous beam with the absorption of the homogeneous radiation of given wavelength. In principle it is the measurement of the fraction of the radiation that passes through a given thickness of aluminum or copper. For potentials up to 130 kv., 4 mm. of aluminum are used, and for high potentials 1 mm. of copper. Graphic charts[1] have been published from which the effective wavelength is easily estimated from the percentage of transmitted radiation.

3. The absorption measurement through *filter analysis* determines the quality by comparison of the relative intensity before and after filtration, the diminution in the intensity caused by passing through the filter being the sum of the absorption and the scattering.
4. The *minimum wavelength* emitted from the target of a roentgen tube is related to the potential at the terminals of the tube by a formula developed from the work of Planck, Einstein, Duane, and others. With a knowledge of the exact potential which excites roentgen rays, we can define their quality by means of the minimum wavelength.
5. The direct measurement of quality by instruments known as *qualimeters* or *penetrometers* has been largely displaced by the more accurate absorption methods here described. The Benoist and Wehmelt penetrometers and the Bauer qualimeter are still in occasional use.
6. *Kilovoltmeter measurement* means the expression of quality in terms of kilovolts. The wavelength being dependent upon the voltage applied to the x-ray tube, such a relation is feasible. Calibrations based upon an electrostatic voltmeter placed in the secondary circuit are reliable, but in clinical work this type of meter is necessarily replaced by an alternating current voltmeter in the primary circuit, from which estimations of the kilovoltage in the secondary circuit are calculated. This manner of estimation of quality, as has been stated, is open to many errors.

Quantity.—The intensity of a beam of x-ray in a physical sense is defined by the measurement of its energy in a unit of time. The dose, the intensity, and the time are interdependent variables. The radiosensitivity of a tissue cannot be measured purely and simply by a dose without having the intensity and the time intervene. The action of a feeble dose administered over a long time is occasionally slightly different from that of a stronger dose applied for a shorter time, especially upon mitoses. The chronological order of the treatments by radiations must be determined by taking into account the nature and the behavior of the pathologic process which the irradiation modifies or suppresses.

The intensity of the radiation from an x-ray tube has, at different points at the same distance from the focus point, quite different values, but it is principally affected by increase of distance from the source to the irradiated object.

Quantity is expressed in biological terms—erythema dose, epilation dose—or is measured by electrothermic, fluorescent, chemical, or electrophysical means.

Biological standards of measurement involve the patient's reaction and the radiologist's interpretation of that reaction. Both of these are variants and impossible to standardize. An *erythema dose* (E. D.) is the smallest quantity of radiation which will produce a first degree reaction, *i. e.*, a faint pink erythema. This reaction usually ensues five to seven days after exposure, persists for one week, then disappears. It is generally followed by epilation of the hair in the exposed area. The hair falls out about seventeen days after treatment, causing temporary alopecia, and regrows in two or three months. A slightly smaller amount of irradiation is required to make the hair fall out than to produce an erythema; consequently, an *epilation dose* is slightly less than an erythema dose.

In general, the depth, duration, and intensity of the erythema vary according to the quality of the radiation, so that to define the amount of x-rays applied entirely by the production of an erythema is insufficient.

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[1] Duane, W., Hudson, J. C., and Sterling, H. N.: The Measurement of Effective Wavelengths, Am. J. Roentgenol., 20: 241–245, Sept., 1928.

Leddy and Weatherwax have concluded, after a large number of observations, that the maximum variation in the time in which a reaction of normal skin, definable as an erythema, can be produced with roentgen rays is at least 50 per cent, and that the erythema (skin unit) dose is a flexible, arbitrary, and inaccurate standard. Dosimetry based alone on it has a relative value individual to the judgment of the radiologist.

Erythema and epilation exposure, however, have been useful biological measurements of dosage since the discovery of x-rays, and as general terms will undoubtedly persist indefinitely. They are most informative when they are suffixed by the factors and the ionization measurements.

Whenever we need a dosimeter that ideally fulfils the biological requirements under all conditions, the physical dosimeter is insufficient without further reckoning, and there must be a biological equivalent (Bachem). It is not to be hoped that the dosage problem in radiation therapy will be solved by physical dosimetry alone.[1] Recognizing this fact, various investigators have used ascaris eggs, plants, and other simple forms of life for biological measurements of dosage. Welsch has studied the effects of x-rays upon the capillaries by the use of the capillary skin microscope and has concluded that the critical evaluation of what is normal and what is pathologic has difficulties. The individual variations in the skin capillary system are enormous, with vicarious changes in the capillary network peculiar to the individual. He concludes from his observations that it is not possible to use the physiologic changes in human capillaries as an exact method of measurement of the physical dose of x-rays. The biological changes as the result of roentgen therapy are so slight as to be scarcely differentiated from a physiologic constant. The individual reaction of the irradiated skin also plays an important rôle in the estimation of measurements.

In superficial therapy in this country, *simple chemical and electrophysical dosimeters*, for instance, the Sabouraud-Noiré pastille, the Holzknecht radiometer, and the Fürstenau intensimeter, have been almost entirely discarded for measurements based upon ionization or indirect calculation.

The Sabouraud-Noiré method of measurement, especially the modification by Holzknecht, is still a valuable dosimeter and is widely used abroad. Pastilles are thin strips of white paper coated with an emulsion of platinocyanide of barium, which in actual use are placed half the anode-skin distance between the target and the patient. This double salt changes color upon exposure to x-rays, turning from a crystalline to an amorphous state, due to loss of the water of crystallization. The color changes from a greenish yellow to yellow and, upon further exposure, to orange. Corbett states that the unexposed pastille is a mixture of yellow and blue and that the blue gradually disappears until at a point just below one-half epilating dose (half-distance) where yellow is the only color present. Upon further exposure red appears, causing an increasingly orange-brownish tint.

The Fürstenau intensimeter depends upon the alteration of the resistance of selenium. The selenium cell is not constant but shows signs of fatigue, and variations of 27 per cent in the readings have been recorded. A new model is said to permit the correction of this error. The scale of the instrument is calibrated in F. per minute. Approximately 60 to 70 F. of unfiltered, medium soft radiation correspond to an erythema dose. For filtered radiation the number of F. units will be much higher. Bachem has developed a formula containing a physicobiological factor based upon ionization measurements with a Fürstenau instrument.

Equivalent units of quantity
5 H units (Holzknecht)
= Tint B (Sabouraud-Noiré; pastille)
= 10 x units (Kienböck; photographic plate)
= $1\frac{1}{4}$ skin units (Holzknecht skin distance)
= Villard dose

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[1] Holthusen in Meyer, H.: Lehrbuch der Strahlentherapie, Bd. 1, p. 330.

Ionization Measurement.—The power of electrostatic waves to ionize air is utilized in numerous instruments called ionization chambers or iontoquantimeters applied to the estimation of radiation dosage. When x-rays pass through a gas they establish in it a temporary electrical conductivity, the magnitude of which is determined by the number of ions formed, and thus by the amount of energy absorbed by the gas. By the use of a delicate electroscope the minute current permitted to flow through the gas is measured. Measurements made in this manner are expressed in various units. There seems to be a general agreement that the most significant unit proposed is one based upon the ionization of air because the ionization is proportional to the energy of the radiation.

Ionization measurements are of greatest clinical use when the ionization chamber[1] is permanently affixed to the under surface of the lead-lined box containing the x-ray tube, but this position is impossible with the anode-skin distances ordinarily used in superficial therapy because of the proximity of the patient and the resultant danger of sparking.

The advantages of ionization measurement over coloration tests are that (1) the large errors due to personal equation in the estimation of color tints do not exist, and (2) measurement is made without regard to wavelength, whereas with pastilles the color changes are proportional only to the effects of a particular quality of radiation.

In the ionization chambers the absorbing substance is air, the absorption of which, as has been said, changes according to wavelength in much the same manner as water and as tissue. If one employs a simple ionization set consisting of a chamber, an electroscope, and a scale for reading the deflection of the needle, in which the scale has been calibrated by the manufacturer so that the operator can read in some standard unit, a very limited knowledge of physics is required to make the estimations. The dimensions of the chamber and the material of which it is made must suit the clinical use for which it is intended; as far as possible the scale of wavelengths covered by the instrument should be extensive, with absorption paralleling the biological effects.

The Standard International Unit.—The electrostatic unit was introduced into dosimetry long ago, but there were slight variations in defining it until recently, when the standard international unit[2] was adopted. The standard unit of the roentgen-ray dose—called one roentgen—is that dose which under normal conditions (18° C. and 760 mm. Hg) produces by saturation and ionization one electrostatic unit in a volume of 1 cc. of atmospheric air completely surrounded by a substance which has the same effective atomic number as atmospheric air (7.69).

The roentgen dose unit can be determined experimentally by the air ionization chamber, which instrument is only used to calibrate and to standardize all types of dosimeters. By means of properly calibrated and standardized dosimeters the roentgen dose unit is transferred from the laboratory to the treatment room.

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[1] Failla, G.: Criteria for the Design of a Standard Ionization Chamber, Am. J. Roentgenol., 21: 47–63, Jan., 1929.

[2] Transactions, International Congress of Radiology, Stockholm, July, 1928 (to be published). Glasser, O., and Portmann, U. V.: The Standardization of the Roentgen Ray Dose, Am. J. Roentgenol., 19: 47–57, Jan., 1928. Glasser, O., Portmann, U. V., and Seitz, V. B.: The Demonstration of the Standardization of the Roentgen Ray Dosage, Radiol., 10: 284–291, April, 1928. Meyer, W. H., and Glasser, O.: Further Studies on the Influence of Radiation Quality on the Erythema Dose Measured in Physical Units, Radiol., 8: 311–316, April, 1927.

The practical application of the roentgen unit in the treatment room is made by correlating the skin effect with it. The number of roentgen units necessary to obtain an erythema dose or a skin unit dose must be determined by means of an air-wall chamber directly on the skin of the patient. "This can be done only by the use of a small ionization chamber of the air-wall type, which correlates the total direct dose from the focus with the back-scattering from the patient. This measurement of the total dose is accomplished under any condition of size or shape of field, or volume, or density of tissue, and is therefore the actual dose which the skin receives. The number of roentgen units per erythema dose depends upon the radiation quality when large portals of entry are used. However, if the field of radiation is small, there is apparently little or no variation in the effect of equal doses of radiation of different qualities. . . . Any discussion as to the number of R-units which are required to produce an erythema is somewhat academic except from the standpoint of determining a maximum skin tolerance, since really the important matter is the measurement or calculation of the intensity which may affect an area that is under treatment."[1] The number of roentgen units received deep beneath the skin for given conditions of radiation can be obtained from isodosage charts.

Indirect Measurement.—Roentgen-ray dosage can be estimated indirectly by measuring the electrical energy used in its production; the output of the tube being determined from the factors which produce the radiation—kilovoltage, milliamperage, filtration, focus skin distance and time—as has been shown. The output can also be determined indirectly by the instrumental measurement of the quality and quantity of roentgen rays created. No practical method has been found so far to measure roentgen-ray energy directly.

The indirect method of measurement is based upon the assumption that a measurement made before or at the beginning of each exposure will serve accurately as a unit for measuring the dose throughout the entire duration of the exposure. Although theoretically such constancy of output might be attained by an *x*-ray apparatus, practically it is found that many more or less outside factors cause fluctuations in the output during an exposure. Of these, the most important is the line voltage, which indirectly influences the tension and current strength in the secondary circuit, causing fluctuations in the milliamperemeter readings. Changes in line voltage may be registered by the use of a voltmeter. In electron *x*-ray tubes, fluctuations in the filament current also influence the constancy of *x*-ray output, as will be perceived from an ammeter placed in the filament circuit.

To quote from Glasser and Portmann: "In this procedure the attempt is made to transfer from one therapy apparatus to another such mechanical factors as kilovoltage, milliamperage, distance, filter, etc., with the expectation that when these technical factors are reproduced the radiation output also will always be duplicated. In its simplest form this method is usually based upon a mathematical formula made up of these mechanical factors from which the operator expects to calculate the exact radiation dose. In order to test this method we have calibrated 130 roentgen therapy machines within the past five years.

"We have found that under identical working conditions, if we depend solely upon mechanical factors, the radiation output actually varies almost 100 per cent when hard filtered rays are used, as in deep therapy, and approximately 150 per cent when light or unfiltered radiation is used, as in superficial and skin therapy. Any mathematical calculation or any mechanical transfer of a certain roentgen dose from one roentgen laboratory to another seems to be practically impossible on account of the variability of the machines and tubes."

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[1] Portmann, U. V.: Measurement of Radiation Dosage, Am. J. Roentgenol., 21: 173, Feb., 1929.

In the indirect method, the milliammeter is used to measure the current passing through the tube, and the number of milliamperes multiplied by the volts gives the energy developed in the tube. The dosage received by the object irradiated depends upon the quantity generated, the duration of the exposure, the distance, the absorption of intervening tissues, and the filtration.

The use of mathematical formulas containing the above-mentioned factors for the computation of dosage is involved and necessarily inaccurate. Scattering, structural variations in different machines, alterations in the size of the areas exposed and diversities in output of Coolidge universal type tubes are inconstant factors which are not included in such formulas. Another important inaccuracy is the use of a point gap of fixed length as a factor in the formulas instead of, and as equivalent to, the voltage passing through the tube. The length of a point-gap sparkover induced by a high tension current is determined not simply by the voltage of that current but also by other conditions. The more important of these and the manner in which they affect the sparkover may be briefly indicated under the following headings: (1) Character of the potential; (2) physical state of the air; (3) corona or brush discharge; (4) variations in the shape and size of the terminals; (5) the personal equation. As has been stated, at present voltage determinations are best made by the use of a sphere-gap as a permanent part of the equipment.

Discrepancies and inaccuracies, however, have not prevented the widespread use of formulas for the measurement of dosage, which are readily adapted to the conditions of office practice. For unfiltered radiation the formula of Shearer[1, 2] is most acceptable.

$$\frac{\text{current} \times \text{voltage}^{3} \times \text{voltage} \times \text{time}}{\text{distance} \times \text{distance}} = \text{dose}$$

A standard is determined by biological tests to establish the erythema dose on human skin with a certain set of factors. Let us assume, for instance, that a series of skin tests with a particular apparatus using the set-up of 2 ma., sp. g. 6″ (100 kv.), distance 8 inches, reveals that a mild erythema is produced by an unfiltered exposure of three minutes. Then, substituting these findings in the formula, we have:

$$\frac{2 \text{ ma.} \times 100 \text{ kv.} \times 100 \text{ kv.} \times 3 \text{ minutes}}{\text{distance } 8'' \times \text{distance } 8''} = 1 \text{ E. D.}$$

As long as other factors remain unchanged, the following conclusions are practical:

1. Doubling the milliamperage doubles the dose.
2. Doubling the duration of the exposure doubles the dose.
3. Doubling the voltage quadruples the dose.
4. Doubling the distance quarters the dose.

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[1] Shearer, J. S.: Factors Governing Photographic Action of Roentgen Rays, Am. J. Roentgenol., 2: 900–903, Dec., 1915. Dosage, Ibid., 3: 298, June, 1916.

[2] MacKee, G. M.: *x*-Rays and Radium in the Treatment of Diseases of the Skin, Philadelphia, Lea & Febiger, 1927, p. 254.

[3] The voltage referred to is peak voltage of the current passing through the *x*-ray tube and not the voltage at any place upon the high tension circuit.

Dosage in Superficial Therapy, Unfiltered.—Practical measurements of dosage for superficial therapy with unfiltered radiation have been made in this country largely by biological effects (erythema dose) or indirect mathematical computation (skin unit).

The *erythema dose*[1] has been described. Although variable, it is a necessary complement to all other methods of measurement.

The precisions afforded by modern apparatus have reduced the errors of indirect measurement to such a degree that it is possible, with an accuracy sufficient to meet practical requirements, to duplicate a dose by repetition of an established technic with the same apparatus and same tube. MacKee, and Remer and Witherbee stated that the factors—6-inch pointed spark gap (100 kv.), 2 ma. at an 8-inch distance for an exposure of three minutes' duration, unfiltered, with the modern type of apparatus having an interrupterless transformer and a Coolidge tube—produce a mild skin reaction in the average individual, usually an erythema on sensitive parts or an epilation without an erythema on the scalp. This was taken as a standard of measurement and was designated one *skin unit.* Consequently, the unfiltered skin unit has been a convenient form of expressing the reaction caused by the factors, 6-inch spark gap, 2 ma. 8-inch distance for three minutes. It has been of widespread use. It is important to appreciate that these factors do not always produce the same reaction, and they should be corrected by biological skin tests by each operator for each machine and for each tube.

With the realization that the arithmetically computed skin unit is intrinsically inaccurate and must in each case be checked by skin tests, the antecedent term "erythema dose" (E. D.) is more and more being substituted for the term "skin unit."

Fractional.—In this method of application the maximum effect is produced by applying small doses repeatedly at short intervals over a considerable period. The interval between doses (three days, one week, ten days, two weeks) is so short that the tissues do not have time to recover from the radiation effects of one dose before they are subjected to others. The effect is thus cumulative. When the treatment is continued over a period of more than a few weeks, the skin should be carefully watched for evidences of irritability which precede the onset of erythema. These evidences are (1) rapid hyperemia following stroking or slapping or the application of warmth to the skin; (2) the onset of dryness due to inhibition of the sweat and sebaceous glands, or (3) epilation (see page 140). Fractional dosage consisting of $\frac{1}{4}$ E. D. weekly is generally employed on all simple inflammatory diseases in adults. In widespread diseases there is danger of systemic reaction from treating more than ten areas at one sitting with this dose.

Subfractional.—Subfractional treatment consists of even smaller exposures, *e. g.*, $\frac{1}{8}$ E. D. once weekly. This dosage is applied to children for the treatment of simple inflammatory dermatoses and is used on very acute inflammations in adults. On the hairy scalp and eyebrows $\frac{1}{8}$ E. D. weekly may be repeated for a maximum of four weeks without danger of epilation. After such a course of treatment an interval of at least six weeks should elapse before further irradiation is applied if epilation is not desired. Even smaller fractions are sometimes used—1/16 E. D. or 1/32 E. D.—mostly upon children.

Intensive.—In contradistinction to fractional treatment, intensive or massive treatment is the application of one or more erythema exposures, *i. e.*, the maximum effect is obtained at once and no repetition of the dose is made for some time. It is used in grave dermatoses, usually of the malignant type, where atrophy, scarring, and cosmetic injuries are of minor importance.

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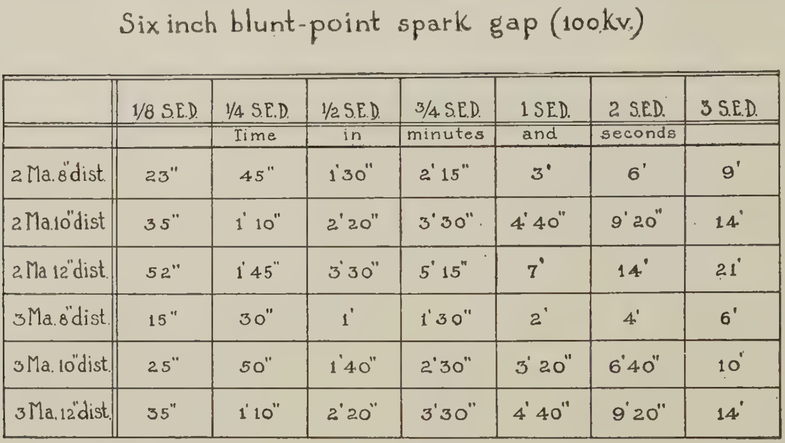
[1] See page 140.



Six inch blunt-point spark gap (100kv.)

	1/8 S.E.D.	1/4 S.E.D.	½ S.E.D.	3/4 S.E.D.	1 S.E.D.	2 S.E.D.	3 S.E.D.
		Time	in	minutes	and	seconds	
2 Ma. 8" dist.	23"	45"	1'30"	2' 15"	3'	6'	9'
2 Ma. 10" dist	35"	1' 10"	2'20"	3'30"	4' 40"	9' 20"	14'
2 Ma 12" dist.	52"	1' 45"	3' 30"	5' 15"	7'	14'	21'
3 Ma. 8" dist.	15"	30"	1'	1' 30"	2'	4'	6'
3 Ma. 10" dist.	25"	50"	1'40"	2'30"	3' 20"	6'40"	10'
3 Ma. 12" dist.	35"	1' 10"	2'20"	3'30"	4' 40"	9' 20"	14'

Fig. 91.—Unfiltered dosage chart.

The average dose on basal-cell epitheliomas is 3 E. D., as high as 4 to 5 E. D. sometimes being indicated. In elderly people these large doses are frequently required to obtain good results. Such dosage should rarely be used on areas larger than 4 cm. in diameter or over bone or cartilage because of the danger of chronic ulcerative radiodermatitis.

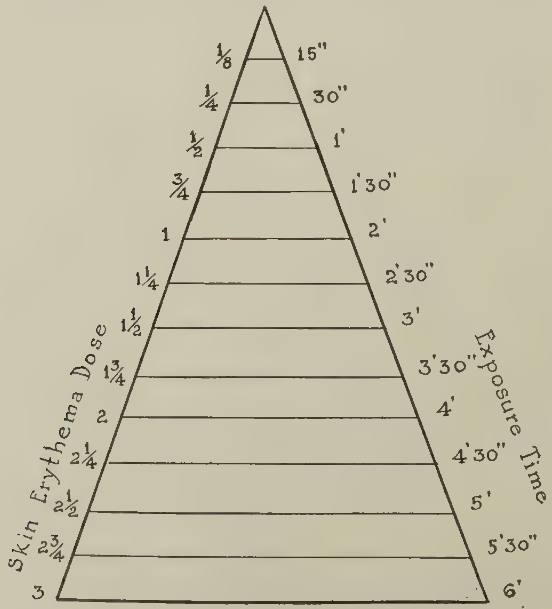


Fig. 92.—Dosage chart for unfiltered superficial therapy using 6-inch spark gap (100 kv., 3 ma., 8-inch distance).

For unfiltered therapy excellent factors are a 6-inch spark gap (100 kv.), 3 ma., two minutes, 8-inch distance; or a 6-inch spark gap (100 kv.), 2 ma., three minutes, 8-inch distance; or a 5-inch spark gap (88 kv.), 4 ma., four minutes at 12-inch distance, each set of which usually produces the mild skin reaction in the average individual equivalent to 1 E. D.

The tables on page 146 have been found by practical use to be generally applicable for unfiltered superficial therapy with modern equipment. Because of differences in various types of equipment, they should be verified by skin tests with each operator's own apparatus before he adopts them.

The following set-ups[1] clinically have proved roughly equivalent when unfiltered radiation is used. By applying the formula given on page 144 it will be seen that the results conform in a general way with the clinical determinations.

$$1\ \text{E. D.} = \frac{3\ \text{ma.} \times 100\ \text{kv. } (6''\ \text{pointed sp. gap}) \times 100\ \text{kv.} \times 2\ \text{min.}}{8'' \times 8''\ \text{dist.}}$$

$$= \frac{2\ \text{ma.} \times 100\ \text{kv. } (6''\ \text{pointed sp. gap}) \times 100\ \text{kv.} \times 3\ \text{min.}}{8'' \times 8''\ \text{dist.}}$$

$$= \frac{4\ \text{ma.} \times 100\ \text{kv. } (6''\ \text{pointed sp. gap}) \times 100\ \text{kv.} \times 5\ \text{min. } 15\ \text{sec.}}{15'' \times 15''\ \text{dist.}}$$

$$= \frac{4\ \text{ma.} \times 91\ \text{kv. } (5''\ \text{pointed sp. gap}) \times 91\ \text{kv.} \times 4\ \text{min. } 5\ \text{sec.}}{12'' \times 12''\ \text{dist.}}$$

$$= \frac{4\ \text{ma.} \times 112\ \text{kv. } (7''\ \text{pointed sp. gap}) \times 112\ \text{kv.} \times 2\ \text{min. } 45\ \text{sec.}}{12'' \times 12''\ \text{dist.}}$$

$$= \frac{3\ \text{ma.} \times 120\ \text{kv. } (8''\ \text{pointed sp. gap}) \times 120\ \text{kv.} \times 1\ \text{min. } 25\ \text{sec.}}{8'' \times 8''\ \text{dist.}} = 1\ \text{S. U.}$$

= tint B. Sabouraud-Noiré pastille = four Holzknecht units with pastille at one-half skin-anode distance.

These are roughly biological equivalents and produce a mild erythema on sensitive parts in the average individual, or epilation without erythema on less sensitive parts.

The above dose is applicable to epilation for ringworm of the scalp, or the treatment of verrucous indolent lesions, such as warts, lichen planus hypertrophicus, lupus vulgaris, and keloid.

Fractions of this dose, usually given as one fourth of a skin erythema once weekly, are the routine treatment for all benign dermatoses.

$$\tfrac{1}{4}\ \text{E. D.} = \frac{3\ \text{ma.} \times 100\ \text{kv. } (6''\ \text{pointed sp. gap}) \times 100\ \text{kv.} \times 30\ \text{sec.}}{8'' \times 8''\ \text{dist.}}$$

$$= \frac{2\ \text{ma.} \times 100\ \text{kv. } (6''\ \text{pointed sp. gap}) \times 100\ \text{kv.} \times 45\ \text{sec.}}{8'' \times 8''\ \text{dist.}}$$

$$= \frac{4\ \text{ma.} \times 91\ \text{kv. } (5''\ \text{pointed sp. gap}) \times 91\ \text{kv.} \times 1\ \text{min.}}{12'' \times 12''\ \text{dist.}} = \tfrac{1}{4}\ \text{S. U., etc.}$$

For neoplasms, and sometimes for tuberculous and other serious affections, intensive treatment consisting of larger exposures than an erythema dose, for example, 2 E. D., is employed.

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[1] The above set-ups presuppose the use of the Coolidge medium or the broad focus tube, and a modern type of apparatus containing an interruptless transformer or autotransformer. They should not be applied to therapy with any apparatus until substantiated by biological and physical measurements upon the particular equipment; but may serve as a basis for such determinations.

$$2\text{ E. D.} = \frac{3\text{ ma.} \times 100\text{ kv. } (6''\text{ pointed sp. gap}) \times 100\text{ kv.} \times 4\text{ min.}}{8'' \times 8''\text{ dist.}}$$

$$= \frac{2\text{ ma.} \times 100\text{ kv. } (6''\text{ pointed sp. gap}) \times 100\text{ kv.} \times 5\text{ min.}}{8'' \times 8''\text{ dist.}}$$

$$= \frac{4\text{ ma.} \times 91\text{ kv. } (5''\text{ pointed sp. gap}) \times 91\text{ kv.} \times 8\text{ min.}}{12'' \times 12''\text{ dist.}} = 2\text{ S. U., etc.}$$

Dosage in Superficial Therapy, Filtered.—If, for the sake of safety, the operator limits his technic to a few routine set-ups, it is advisable to have a distinct change in quality of radiation for filtered treatments from that used in unfiltered therapy. It is usually desirable to employ a filter of at least 3 mm. of aluminum in order to obtain a fairly uniform penetration. Suitable set-ups for filtered treatment are 136 kv. (9-inch blunt-point spark gap), 5 ma., 10-inch distance, and 120 kv. ($7\frac{5}{8}$-inch blunt-point spark gap), 5 ma., 10-inch distance. A mild skin reaction consisting of erythema or epilation is usually produced by an exposure of eight minutes with the former and ten minutes with the latter. As the exposure time necessary to produce an erythema is different with various types of apparatus, it should be established by biological tests. The following dose charts which are used by the author may be of assistance to the beginner in determining the skin erythema dose for his own installation.

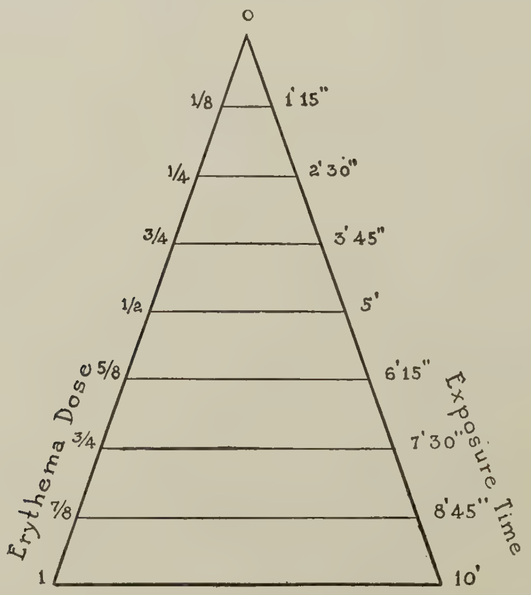


Fig. 93.—Dosage chart: 5 ma., 120 kv. (8-inch pointed spark gap), 10-inch distance; 3 mm. aluminum filter.

Fractional.—The same principle applies to fractional filtered dosage as described under the fractional method of using unfiltered radiation. Small doses at frequent intervals tend to cumulative effects. With filtered radiation, however, the rate of dissipation of the tissue effects is slower than with unfiltered, so that the residuum in the tissues at a stated interval after an equivalent dose is presumably greater for the penetrating than for the soft radiation.

Fractional therapy consisting of $\frac{1}{4}$ or $\frac{1}{5}$ E. D. weekly is frequently employed for deep-seated lesions or those which are verrucous, infiltrated, or thickly crusted. Overlapping may be permitted to a reasonable extent, but no more than eight areas should be treated in one day with this dosage because of the danger of inducing nausea or systemic effects.

Subfractional.—One eighth or smaller fractions of a filtered erythema dose may be given at approximately weekly intervals. Such dosage is applied frequently to children and occasionally to adults. It is particularly useful upon extremely radiosensitive deep-seated lesions, such as tuberculous adenitis, lymphogranuloma, mycosis fungoides, and kindred diseases.

Intensive.—Filtered intensive exposures consist of 1 to 4 E. D. given in a single treatment for dynamic effect. The dose is not repeated for at least a long interval. Intensive dosage with penetrating radiation is the most effective method of roentgen treatment of large elevated or deeply infiltrated growths. The average employed upon epitheliomas is 2 to 3 E. D. At times increased benefit results from cross-firing. In order to avoid chronic ulcerative dermatitis these large doses should not be applied directly over bone or cartilage or upon areas greater than a few centimeters in diameter. The dose should not be repeated until the reaction from the preceding exposure has completely disappeared, usually in six to ten weeks.

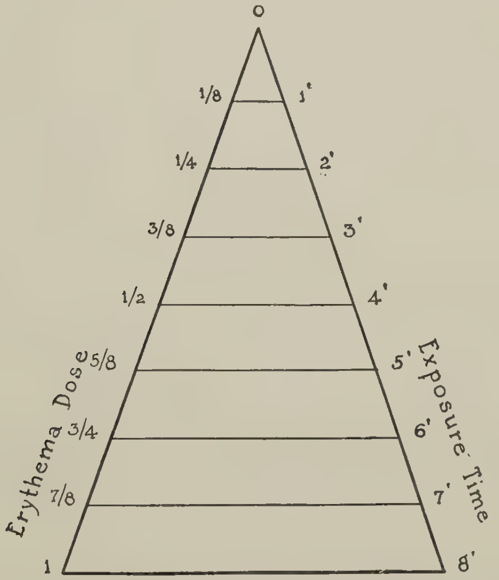


Fig. 94.—Dosage chart: 5 ma., 136 kv. (9-inch pointed spark gap), 10-inch distance; 3 mm. aluminum filter.

Comparison of Unfiltered and Filtered Radiation.—That x-rays of certain wavelengths exert special action upon living matter is doubtful. If there is any such action at all it is too small to be of importance in the range of the x-ray spectrum at present used for therapy.

The apparent differences in effect between unfiltered and filtered radiation mostly resolve themselves into the problem of concentration of the absorption of the radiant energy. Measurements of intensity below the surface with different qualities of x-rays have indicated the desirability of filtration in pathologic conditions more than a few millimeters in thickness.

Schreus calls attention to the fact that heavily filtered x-rays, the penetration of which is not necessary to produce benefit in superficial conditions of the skin, cause injuries to the blood, connective tissue, and deeper-lying organs. His comparison of lightly filtered x-rays with unfiltered therapy has shown no preference for the former over the latter in the treatment of superficial dermatoses. In his experience, equally good results are obtainable with unfiltered radiation with less general effect.

From a purely physical standpoint, the soft rays are absorbed mostly in the epidermis and in the papillary bodies. If there is no thickened, horny, or crusted condition, the healing power is sufficient.

However, many points favor the use of filtered radiation. Even in the therapy of very superficial lesions it may deserve consideration. There is a general impression that a greater latitude exists between the epilation and the erythema doses with filtered than with unfiltered radiation. This is of distinct importance in the treatment of diseases of the bearded region, where epilation is desired without provoking an erythema. Although it is probable that atrophy and telangiectasis occasionally supervene without a preceding erythema, generally avoidance of an erythema is likewise avoidance of these sequelae. With filtered radiation, a greater latitude also exists between an erythema exposure and a third degree burn with ulceration than with unfiltered radiation, although, of course, the latter is more superficial and heals more quickly.

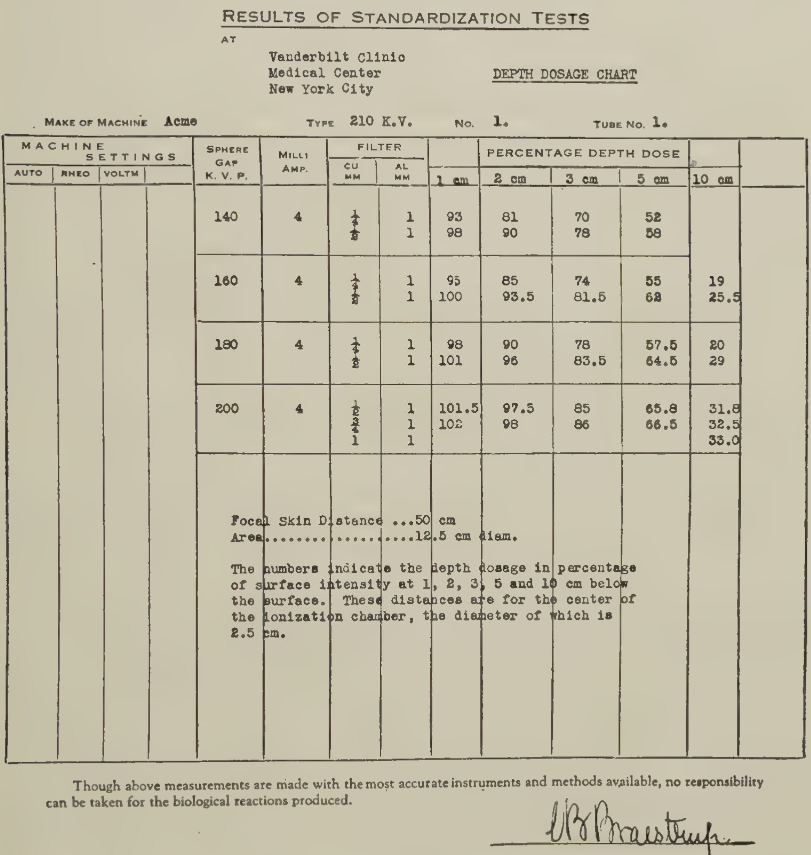
In the treatment of even superficial epitheliomas, one filtered erythema exposure usually evokes greater improvement than one unfiltered erythema exposure, and two filtered erythema exposures also accomplish better results than two unfiltered ones. The response of deep-seated, verrucous, or indurated lesions to filtered irradiation is often more favorable than to unfiltered exposures. Even in the treatment of simple inflammatory dermatoses such as acne vulgaris, the former is often resorted to after the latter has failed to produce satisfactory response. Many other clinical results in dermatology seem to prove that filtered radiation is frequently more effective than unfiltered radiation.

Unfiltered x-rays, however, are easier to apply and are commonly thought to be easier to measure. Ulcerations from them after excessive irradiation are less serious. Epilation of the scalp in tinea capitis without nausea, headache, or syncope is an advantage possessed by soft radiation. For these reasons, the popularity of unfiltered radiation is general.

Dosage for Deep Therapy.—In the treatment of neoplasms that extend more than 1 cm. beneath the surface of the skin, either high voltage x-rays or radium is essential. It is, therefore, necessary for the dermatologist to be acquainted with the use of both of these agents. The measurement of the depth dose in the case of x-rays is determined under practical conditions by the use of a water phantom which acts as a substitute for tissue, the ionization chamber being placed in the phantom.

Separate determinations are made by a physicist for various voltages, filters, and sizes of fields, at distances below the surface, and from these results a depth dosage chart is arranged. The accuracy must be verified by monthly repetition of the tests, and, of course, by the examination of new tubes or other new equipment. One of the best checks upon the constancy of the output is an ionization dosimeter permanently attached to the treatment drum. Appended are examples of such a chart, and of curves showing the depth dosage.

In addition to the determination of the percentage of surface radiation intensity which is effective at various depths, it is necessary to establish the exposure time which produces a skin erythema with various voltages, filters, and sizes of areas.



RESULTS OF STANDARDIZATION TESTS
AT
Vanderbilt Clinic
Medical Center
New York City

DEPTH DOSAGE CHART

MAKE OF MACHINE Acme TYPE 210 K.V. NO. 1. TUBE NO. 1.

MACHINE SETTINGS			SPHERE GAP K. V. P.	MILLI AMP.	FILTER		PERCENTAGE DEPTH DOSE				
AUTO	RHEO	VOLTM			CU MM	AL MM	1 cm	2 cm	3 cm	5 cm	10 cm
			140	4	1/4	1	93	81	70	52	
					1/2	1	98	90	78	58	
			160	4	1/4	1	95	85	74	55	19
					1/2	1	100	93.5	81.5	62	25.5
			180	4	1/4	1	98	90	78	57.5	20
					1/2	1	101	96	83.5	64.5	29
			200	4	1/2	1	101.5	97.5	85	65.8	31.8
					3/4	1	102	98	86	66.5	32.5
					1	1					33.0

Focal Skin Distance ...50 cm
Area.....................12.5 cm diam.

The numbers indicate the depth dosage in percentage of surface intensity at 1, 2, 3, 5 and 10 cm below the surface. These distances are for the center of the ionization chamber, the diameter of which is 2.5 cm.

Though above measurements are made with the most accurate instruments and methods available, no responsibility can be taken for the biological reactions produced.

CB Braestrup

Fig. 95.

Practical Applications of Depth Dosage Measurements.—From the clinical examination of the lesion to be treated, its width, depth, and shape are determined. With these in mind, one decides on the size of area to be exposed, and the depth at which an effective dose is desired. According to the estimated degree of radiosensitivity of the lesion, the effective dose may be large or small, and the proper amount has to be carefully decided in each instance. After the desired dose at a certain depth through a cone of a determined size is adjudged, the most suitable set-up to deliver such a dose without undue damage to overlying structures may be ascertained by consulting the depth and erythema dosage charts.

Saturation Method of Dosage.—This method of treatment was originated by Kingery. Pfahler has had most satisfactory results with it. The saturation method in roentgen therapy "consists in the delivery of an eryth-

TABLE 4

ERYTHEMA DOSE CHART

Machine settings.				Sphere gap.	Milli-amp.	Filter.		Galv.	Erythema time in minutes.			d½ mm. Al.	Intern. r-unit.
Auto.	Rheo.	Voltm.	Volt.	Kv. P.		Cu. mm.	Al. mm.		2.5 cm.	7.5 cm.	12.5 cm.		
14	14	40	51.5	140	4	¼ ½	1 1	19.5 13.0	98 182	72 135	66 123	8.5 10.0	750 825
16	16	43.5	58.5	160	4	¼ ½	1 1	21 14	87 151	64 112	58 101	9.0 10.0	790 860
18	17	47.5	70.0	180	4	¼ ½ ¾	1 1 1	23 15.5 12.8	71 123 171	52 90 123	47 82 112	9.5 11.5 12.5	825 890 925
20	19	51	79.0	200	4	½ ¾ 1	1 1 1	16.5 13.6 11.8	113 148 190	82 108 135	74 96 122	12.0 14.0 14.5	925 960 975

Make of machine ACME. Type 210 kv. A. C. Mech. rect. Tube No. 12.

The r-units refer to unit adopted by the Bureau of Standards and include back-scattering.

The erythema times were measured with a *focal skin distance* of 50 cm. and three fields having the diameters indicated above.

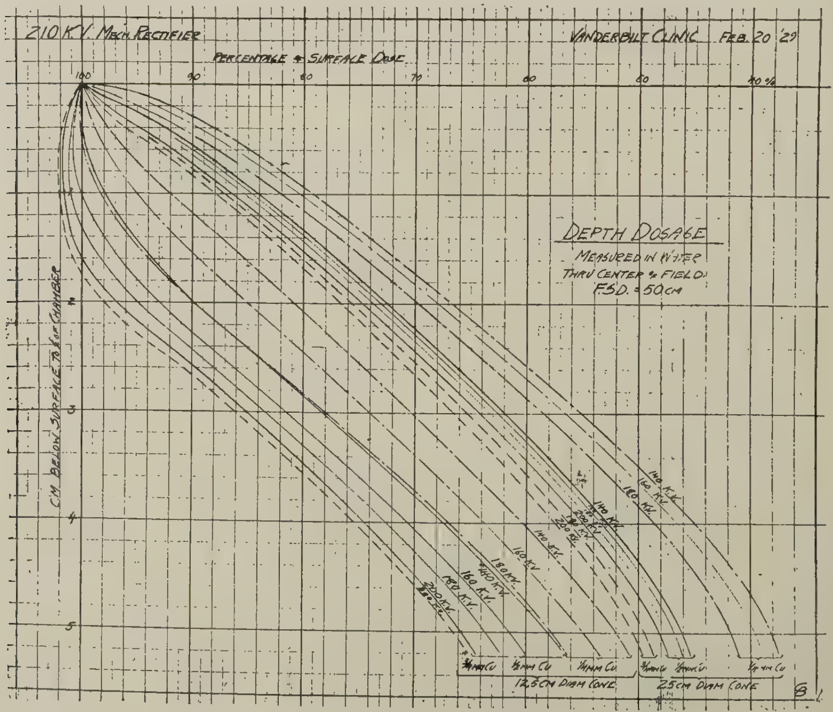


Fig. 96.—Depth dose curves for 12.5 and 25 cm. cones.

ema dose into the diseased tissue, either as a single or cumulative dose, and then maintaining this effect for a certain time by means of additional smaller doses to correspond to the loss in effect during any given period." The advantages of a single massive dose in its destruction of malignant cells are obtained by applying the maximum radiation in the shortest time; and all cancer cells are probably radiated during their process of division by maintaining this maximum effect for ten to fourteen days. As the dose is considerably divided, the general organism is not severely affected. There is the difficulty, however, of determining how long to maintain this saturation effect in each individual case, without incurring a severe burn. There is also a greater consumption of time in arranging the patient for many exposures, consequently, involving more expense and a greater opportunity for the patient to discontinue treatment before the cells have been destroyed. Stenström and Mattick have evolved a formula for calculating the relation between the time of exposure and the residual effect of radiation. Failla, however, points out that there is room for disagreement as to merits of the saturation method: "Whether better results are obtained by this method than by another depends on many factors, but in particular it depends on the possible modification of the relative sensitivity of normal and pathologic tissues. It is evident that a much larger dose may be administered to the skin if the treatments are divided over a period of weeks than if a single treatment is given. This means that the skin is more 'resistant' to the divided treatments than to the single treatment. However, it may well be that the tumor is equally resistant to the divided treatment and, therefore, it is not affected to a greater degree by this treatment than by a single irradiation of smaller amount. If this is the case, there is no choice between the two as far as the criterion of tissue sensitivity is concerned. There are, however, other criteria, such as the systemic effect on the patient, *et cetera*, which must be considered also. The problem is very complex and can be solved only by careful observations extending over a long period of time."

ROENTGENOTHERAPY

Radiation of Very Superficial Lesions.—Acute and chronic simple inflammatory diseases involving only the epidermis or subpapillary zone are influenced by fractional unfiltered radiation of $\frac{1}{8}$ to $\frac{1}{4}$ E. D. repeated every three to seven days. Where extensive surfaces are affected a uniform distribution of the radiation is produced by overlapping or by increasing the anode-skin distance. When the lesions under treatment are small, superficial and indolent, relatively large amounts of unfiltered radiation may be given to them, with proper shielding, for the smallness of the exposed area greatly reduces the actual dose. The unfiltered dosage in such instances may be raised to 3 or more E. D. without the danger of more than a second degree reaction. When filtered treatment is employed on very superficial lesions, either in fractional or massive doses, needless injuries to the deeper tissues may be occasionally incurred.

It must be remembered that fractional treatment becomes intensive when repeated at intervals frequent enough to produce an accumulative effect. The treatments must not be made at intervals so far apart that the therapeutic effect is lost, nor so close together that the accumulative effect will produce injuries. In the treatment of simple inflammatory superficial lesions, the total dosage should never exceed 4 E. D., *i. e.*, $\frac{1}{4}$ E. D. is given weekly, and the maximum number of treatments should be sixteen. This total dosage allowable is influenced by other factors in each case, especially the location and size of the area under treatment.[1] When massive doses are given, successive treatments should not be administered until two or three weeks after the disappearance of the erythema, crusting, and edema. Pigmentation is not a contraindication to further treatment.

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[1] Reader is referred to paragraphs on skin toleration and precautions (pp. 133–137).

For the treatment of very superficial lesions radiation produced by 100 kv. (6-inch spark gap), unfiltered, with an anode-skin distance of 8 inches is recommended. This radiation is especially desirable in extensive lesions, as it avoids most of the hazards caused by deep penetration. For all extensive areas the operator may use either larger anode skin distances up to 16 inches or may employ the method of overlapping fields.[1]

Treatment of Lower Strata of Skin.—To obtain a penetration to the lower strata of the skin, as the corium, the hair follicles, the nail matrix, *et cetera*, without injury to the deeper tissue the following technic is suggested: 137 kv. (9-inch spark gap), 3 mm. aluminum, and 5 ma. at 10-inch distance. A skin erythema is produced with this technic within seven to eight minutes.

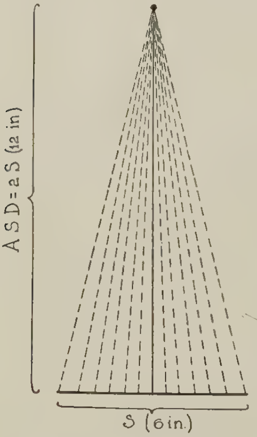

Fig. 97.—Single exposure over a flat field. The equality of intensity distribution is increased as the focal skin distance is lengthened, so that the angle of incidence of the peripheral rays approaches the optimum of 90 degrees.

Epilation of the scalp is produced in about four minutes with these same factors. This radiation is used effectively on the diseases given in Table 6, page 156.

Changes in the above technic may be made as follows: 120 kv. (8-inch spark gap), 2 mm. aluminum, 5 ma., 10-inch distance, with erythema time of seven and a half minutes, or 137 kv. (9-inch spark gap), 4 mm. aluminum, 5 ma. at 14-inch distance with an erythema time of seventeen minutes.

Treatment of Thick or Deep-seated Lesions.—Malignant neoplasms, and occasionally recalcitrant granulomas, require massive exposures of *x*-rays. Two, three, or even four filtered erythema doses may be indicated. Repetitions of treatment should not be made for three weeks after the skin reaction has subsided. The following technic is generally suitable for deep-seated lesions: 170 kv. (12-inch spark gap), 1 mm. aluminum, plus 0.25 mm. copper, 5 ma., 20-inch distance, the erythema time being about forty minutes. However, the most desirable filtration and kilovoltage should be determined separately for each case by estimating the depth of the lesion and the intensity of the required dose, and then consulting the depth-dosage tables, as given on page 152. This radiation can be used to treat areas at a depth of a few centimeters and may even be used for deeper lesions if very large doses are not required. The depth dose may be augmented by cross-firing, so that, although all radiations are directed to one deep-seated lesion, the entire dose does not pass through any one area of skin.

Filtered treatment is especially useful in deep-seated lesions, as the amount of *x*-rays which may be applied to such lesions is limited solely by the toleration of the skin and other structures overlying the lesion. Before reaching the skin, filtration absorbs the soft *x*-rays which form a major portion of the primary beam, and this allows an additional amount of penetrating *x*-rays

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[1] Bachem, A.: The Therapeutic Use of Various Qualities or Roentgen and Radium Ray, J. Radiol., 6: 133–137, April, 1925.

TABLE 5

Clinical Indications for Unfiltered Dosage

Benign processes.			Warty and malignant growths.	
Very acute inflammations.	Simple inflammatory diseases.	Epilation, granulomas, benign tumors.	Small superficial lesions.	Large basal lesions, squamous and small sarcomas.
Subfractional	Fractional.	Subintensive.	Intensive.	Massive.
S. E. D. 1/32 to S. E. D. ⅛	S. E. D. ¼ to S. E. D. ½	S. E. D. ¾ to S. E. D. 1	S. E. D. 1¼ to S. E. D. 2½	S. E. D. 2½ to S. E. D. 4
Semiweekly or weekly.	Weekly, biweekly	Triweekly, monthly.	After disappearance of erythema.	
acute eczema dermatitis venenata	acne vulgaris dermatitis exfoliativa dermatitis herpetiformis dermatitis seborrhoeica dermatophytosis eczema folliculitis hyperidrosis impetigo lichen chronicus (Vidal) mycosis fungoides (early stages) paronychia pityriasis rosea prurigo pruritus psoriasis rosacea sycosis vulgaris tuberculide verruca plana	acanthosis nigricans actinomycosis blastomycosis chancroid clavus condylomata acuminata cutaneous tuberculosis favus of scalp keloid keratosis follicularis leukemia cutis lupus vulgaris sarcoid (Boeck) scrofuloderma tinea capitis (once only) trichophytosis profunda tuberculosis orificialis verruca vulgaris	cornu small basal epitheliomas mycosis fungoides (tumor stage) papilloma verruca vulgaris	large basal epitheliomas very small superficial squamous epitheliomas or sarcomas

to be given a lesion underlying the skin without exceeding the skin tolerance. By the use of several portals of entry, carefully shielded one from the other, irradiation may be focused upon a deep-seated lesion from several directions (cross-firing), thus superimposing the maximum dosage that the skin exposed to each of the separate portals of entry will tolerate. This collective dose upon the lesion may be even greater than the skin dose through any one of the portals of entry. Of course, the intensity through each portal of entry is diminished in its passage from the skin to the lesion by both the inverse law of distance and the coefficient of absorption of the tissues. With *x*-rays of extremely high voltage, heavily filtered, the wavelengths become, from a therapeutic viewpoint, practically homogeneous, and absorption of homogeneous radiation follows an exponential law.

Table 5 (page 155) and Table 6 indicate, in a general manner, the intensity and quality of radiation for numerous dermatoses.

TABLE 6

CLINICAL INDICATIONS FOR FILTERED DOSAGE

Simple inflammatory.	Voluminous infiltrations, granulomas or benign tumors.	Indolent granulomas or malignant tumors.
Fractional.	Suberythema.	Intensive (one to four S. E. D.)
acne indurata bromidrosis dermatitis papillaris capillitii erysipelas erythema induratum hyperidrosis hyperkeratosis of palms and soles hypertrichosis onychomycosis rhinophyma	actinomycosis blastomycosis carbunculosis large keloids lepra nodosa leukemia cutis lupus vulgaris sarcoid (deep type) verruca plantaris	epithelioma rhinoscleroma sarcoma

Treatment Varies with Size of Lesion.—The proper treatment of small lesions is a matter of considerable importance. Unsatisfactory results are usually due to carelessness in focusing the direct beam vertically upon the lesion, or else to improper shielding. It must be remembered that the size of the area exposed influences the intensity of the effect by modifying the amount of secondary radiation produced within the tissues. As has been stated, relatively large doses may be given to small lesions because of the diminished secondary radiation in the tissues. Not infrequently beginners in radiotherapy are careless in the treatment of small lesions, particularly in the cutting of the hole in the sheet-lead used for shielding. The hole should be made of exactly the proper size, with a small sharp-pointed scissors. This seems a small detail, but it is very important. The pathology of most lesions extends somewhat outside the visible skin manifestations. For effective treatment, the hole should be slightly larger than the lesion. For benign lesions, there should usually be exposed an extra margin of at least one-fourth the diameter of the lesion surrounding it. Special technic is required for keloids. Upon most of these the shielding must be close for good cosmetic results, especially those treated by semi-intensive exposures. Shielding should be made within 2 mm. of the edge of the keloid. Occasionally extensive keloids are treated by fractional exposures without much shielding. For small malignant lesions the shielding should not be close, but a margin on each side of the lesion should be exposed at least as great as the diameter of the lesion itself.

Large lesions should be so placed that their surfaces are flat and exactly at right angles to the direct beam of radiation. For equal distribution of dosage an increase of anode-skin distance is often necessary. The magnitude of secondary radiation produced in the exposure of large lesions requires the exercise of a certain amount of caution in dosage, so that undesirable sequelae from overirradiation are not produced. If the lesions are so large that a fairly equal distribution of dosage cannot be obtained, even by increased anode-skin distance, the lesion is subdivided into smaller areas, which are shielded separately from one another, and treated serially when the dosage is intensive or semi-intensive. With fractional technic, such shielding is usually undesirable and equal distribution of dosage is obtained by overlapping.

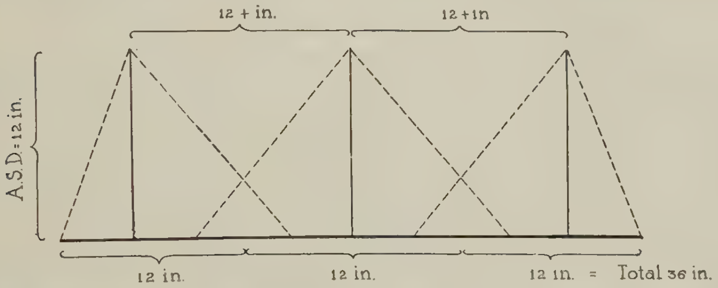

Fig. 98.—Irradiation of a large flat surface by multiple exposures with overlapping.

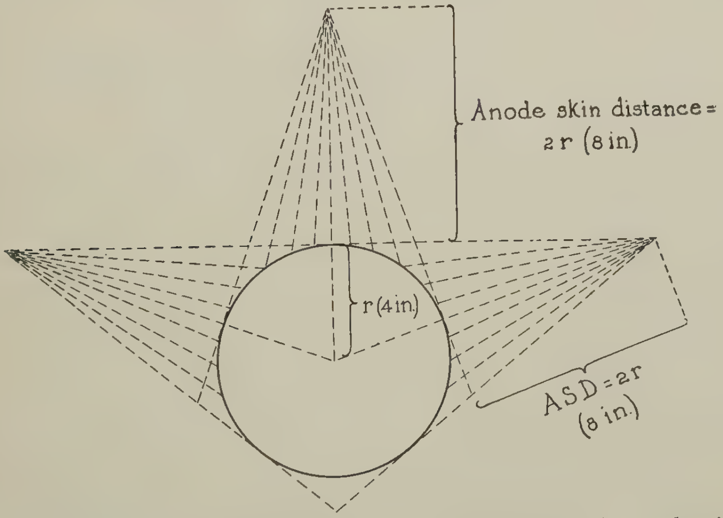

Fig. 99.—Irradiation of convex surface, distributing dose equally by overlapping.

The amount of overlapping increases as the anode-skin distance is increased. With 8-inch anode-skin distance, and a bare tube, a practical homogeneous distribution is effected by placements 18 inches apart.

Treatment of Irregular Surfaces.—When convex surfaces are small the effect of the convexity upon distribution of dosage can usually be overcome by increasing the anode-skin distance and by filtration. On large convex surfaces multiple placements are necessary, with an allowance of overlapping in fractional treatments and with careful shielding for larger doses.

Similar rules apply to concave surfaces. But, in addition, there should be an effort to make the surfaces as flat as possible by tension upon the skin with adhesive strips. Cones are often used in the treatment of small concave parts, particularly the anus, vulva, axillae, auditory meatus, and mouth.

Angular surfaces should be treated by the methods suggested above, especially by subdividing the surface into its flat components and treating each of these separately.

Indirect Roentgen Therapy.—The treatment of dermatoses by indirect roentgen therapy is sometimes effective. Irradiation over the spinal ganglia has given relief in itching skin diseases. This method has been practised and described by Cottenot, Zimmern, Dariaux, Kriser, and others. Pautrier has treated lichen planus through the roentgenization of the sympathetic nervous system. The pruritus in lymphogranulomatosis is influenced by the application of roentgen rays to the affected lymph glands.

The coincidence of dermatological conditions with disturbances of function of the endocrine glands is a basis for roentgen therapy to these organs in some skin affections. Schoenhof has successfully treated a case of universal alopecia areata by roentgen therapy over the ovaries. Psoriasis has been benefited by roentgenization of the thymus by Brocq, Foerster, and Werther. Goeckermann has treated lupus erythematosus by the application of filtered *x*-rays to the lymphatic glands of the body. Herpes simplex, zoster, parapsoriasis, pityriasis lichenoides, and other affections of the skin have responded to indirect irradiation. This form of therapy is at times strikingly effective, and in other instances is absolutely without value. In the author's experience, the best results from indirect radiation have occurred in lichen planus following the method of Pautrier. The pains due to zoster have in a few instances been relieved by roentgen therapy over the spinal ganglia. Several cases of lupus erythematosus treated by irradiation of the cervical lymphadenopathy have been made worse by the treatment.

In the case of pruritus and radicular neuralgia the application of roentgen rays to the roots involved where they emerge from the spine has resulted in a cure in a number of instances. This method of treatment has also been effective in radiculitis of sciatica or the lumbago type.

In general, the technic of indirect therapy consists of full filtered doses given at monthly intervals. When treatment is applied to the spinal ganglia the depth dose is increased by the use of a portal on each side of the spinal column, and the beam of radiation is directed mesially so that it cross-fires at the level of the ganglia. This is further described on page 465.

Although at present indirect roentgen therapy is popular in some circles, I have never been able to achieve results by it which could not be more rapidly and effectively obtained by direct irradiation of the affected areas.

Limitations and Abuse of *x*-Ray Treatment.—Roentgen-ray treatment must be used with discretion, care, and accuracy. Carelessly employed it can be vicious. The dangers are sometimes augmented by too much enthusiasm. The large percentage of cures and improvements effected in skin diseases by *x*-rays has led to an erroneous attitude on the part of some laymen and members of the profession, who recommend a few *x*-ray treatments for any skin condition that does not readily react to medicinal applications. A radiologist may be called upon to treat a dermatosis, and not being a dermatologist, uses *x*-ray treatment solely. A definite diagnosis and the etiologic factors of the dermatosis may not be studied or determined. Skin conditions in many instances are symptoms of underlying disease or precursors of more serious skin changes.

Their treatment is complex, so that only the well-qualified and cautious should attempt diagnosis or the use of these therapeutic agents. Radiation has a power which only experience combined with theoretical knowledge can determine and control. The immediate and remote effects must be understood. The borderline between a stimulating, healing, and destructive dose is so fine that the utmost caution must be observed in order not to overstep the margin. Serious local or systemic injuries are likely to result from the misuse of radiation.

Dermatoroentgenotherapy requires a complete knowledge of the pathologic condition present and a broad training in biophysics, surgery, and clinical dermatology.

Future of Roentgen-ray Treatment.—The future of roentgen-ray therapy depends largely upon augmentation of our knowledge of the biological effects of radiation and improvement in the processes of application. The adaptation of physical measurements of dosage within the tissues to their corresponding biological effects will assist in a closer understanding of the secrets of living matter and the therapy of disease. There is little doubt that, in the course of time, rare dermatoses in which radiation has been employed with good results in only a few cases, and other diseases that have not as yet responded to *x*-ray treatment, will be included among those greatly benefited by this form of therapy.

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CHAPTER VII

SUPERSOFT x-RAYS (w-RAYS, GRENZ RAYS)

Within the last few years the gap between the ultraviolet and roentgen-ray groups has been bridged and the intervening very absorbable radiations have been shown to conform to the established roentgen-ray laws throughout their entire range extending right into the ultraviolet. J. J. Thomson has demonstrated that these supersoft x-rays are produced within the usual x-ray tube, but that they are so absorbable that they do not penetrate the walls of the tube as ordinarily constructed on account of the contents of the glass. By the use of specially made tubes of lithium borate (Lindemann) glass or tubes containing a window either of this glass or thin metal, it has been possible to enable soft rays to leave the tube in sufficient amount to use them in superficial therapy.

Although attempts to use various absorbable radiations upon dermatoses were made in the early days of roentgen therapy (in order to eliminate undesirable sequelae which follow wavelengths ordinarily employed), no important advances were made, and it was not until 1920 when Bucky therapeutically applied wavelengths from 1 to 3 Ångström units that apparent biological and clinical advantages were demonstrated. He employed a Coolidge tube with a window of Lindemann glass, the potential on the tube being less than 10 kv., as with voltages below this the electromagnetic vibrations have a range from 1.5 to 2 Å. u. Because he believed that such long wavelengths showed characteristic biological effects which are observed partly with ultraviolet and partly with roentgen rays, and, in addition, showed new biological effects not obtainable with any of the other rays, he differentiated them by the term "grenz rays," meaning boundary rays. However, his attributions of new and characteristic biological actions to these supersoft rays have not been wholly substantiated and indeed are accepted with increasing limitation.[1] Their influence upon the general metabolism requires further study and their local skin effects are far from being exactly determined, but such peculiarities as exist are probably due to the lack of penetration of the radiation and the consequent absorption of the major fraction of it in the upper layers of the epidermis rather than to any specific action upon a constituent part of the skin. The biological attributes upon which the term "grenz rays" was founded are being largely superseded in popular thought by the physical characteristics of the group. As they are very soft x-rays, it is doubtful whether any special designation is warranted for them. However, Kaye has suggested that the alphabetical sequence would be complete if these absorbable rays were called w-rays, lying as they do between the ultraviolet and the x- and y-rays, and for the sake of convenience his logical proposal is followed throughout this text.

Apparatus.—The apparatus consists of a transformer with both autotransformer and resistance control. The positive side of the transformer is grounded, and the negative potential and the filament current reach the tube through an insulated cable with a grounded, flexible metallic covering. The transformer is especially designed to supply a maximum of 12 kv. and usually averages only 7 to 10 kv., with 8 to 10 ma., applied to the tube. The kilovoltmeter and milliamperemeter are built into the switchboard. The operating current may be obtained from any A. C. line.

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[1] Gabriel, G.: Physikalische und biologische Untersuchungen über die sogenannte Grenzstrahlen, Strahlentherapie, 24: 534–547, 1927. Weitere Untersuchungen über die sogenannte Grenzstrahlung, Ibid., 26: 189–199, 1927.

The tube is of the hot cathode vacuum type with a Lindemann glass window. It differs from the Coolidge tube in several features, being small and, with the exception of the lithium glass window, being entirely surrounded by a metal casing so that it can be manipulated conveniently and safely. The water-cooled conical anode is composed of chromium iron. Its outer surface is constructed so as to furnish good thermal radiation and is connected with a water-cooling device, which consists of a tank of water and an electric pump. The cathode is mounted in the axis of this cone, the target being represented by a ring in the narrow end of it. The lithium glass, having a low atomic weight, permits the passage of rays of wavelengths that would be absorbed by ordinary glass. The originality of the method lies not in the use of this glass, but in that of a voltage of 10 kv., as the usual tensions always produced hard rays simultaneously with the softer rays, with a maximum of energy in the harder sphere and a comparatively small amount of the soft rays. Only such tensions should be used as produce soft rays which are absorbed almost entirely by the upper layers of the skin. Numerous experiments made by Glasser proved that for this purpose the tension should not exceed about 10 kv. Various tubes are illustrated herewith. A indicates the old unipolar tube[1] used by Stern about 1910. B is the Mueller tube with a chromium iron target. C is a similar tube constructed by Siemens and Halske. It has a point focus, as shown; the target is of tungsten. The last two tubes are of ordinary glass with a Lindemann glass window which trans-

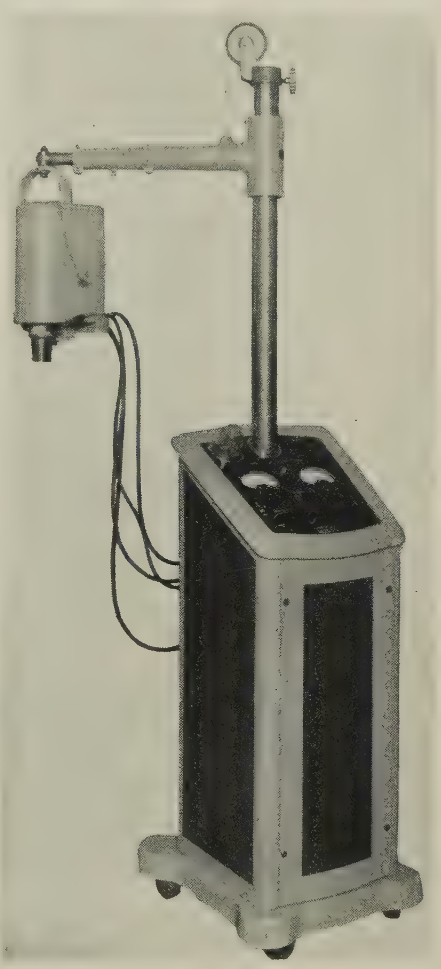

Fig. 100.—Apparatus for long wave roentgen (w-ray) therapy.

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[1] This tube could not be operated at a lower potential than 20 kv. and therefore produced rays of too great penetration. The output was not constant. It would seem that all the older gas tubes which were formerly used for soft ray therapy belong in the same category, that is, they were operated at potentials higher than 10 kv. and were variable in their output.

mits most of the rays. Since the window in these tubes is too small to permit the use of large fields, Glasser and Portmann constructed water-cooled tubes made entirely of lithium glass with targets of various materials. These are illustrated by D. Jacobson asserts that each tube must be calibrated on that apparatus on which it is used in therapy, and that the same tube on different apparatus may have different intensities even for the same quality rays. Two tubes of the same construction, each being used on the same apparatus under the same conditions of voltage and amperage, may have quite different characteristics of quality and intensity.

Physical Characteristics.—In this country the work of Glasser has been outstanding in this field, and I gratefully appreciate his generosity and interest, which have permitted a foundation for the following statements: I have drawn largely from a recent article by him and Portmann

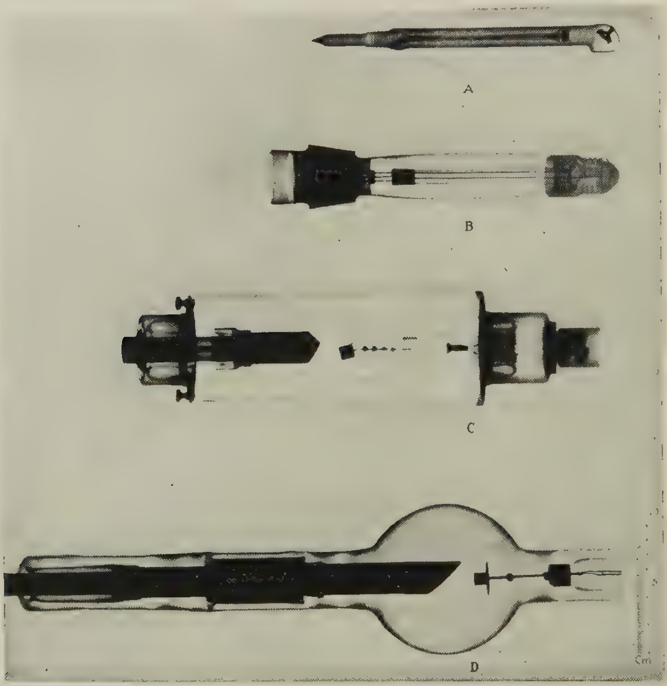

Fig. 101.—Illustration of various tubes used for long wave therapy.

The output from this apparatus is a beam of heterogeneous wavelengths of which the average is about 2 Ångström units (between 1.6 and 2.6 Å. u.), whereas the wavelengths employed in ordinary roentgen therapy range from 1.6 to 0.1 Ångström units. The very absorbable *w*-rays have pronounced ionizing ability and little penetration. The intensive *absorption* is one of the causes of the powerful biologic action of the *w*-rays as only the energy absorbed is able to produce a reaction, and the tremendous concentration of the absorption in the upper layers of the skin is the principal cause of the pronounced effects upon superficial lesions. The average absorption of tissues for the soft rays is about equal to that of water.

Recently Frank has calculated, from their chemical composition, the average absorption of various kinds of tissue such as the epidermis, muscle, *et* *cetera.* From these data Glasser and Portmann have determined the half-value layer in water, muscle, cutis vera, epidermis, and subcutaneous tissue in relation to the half-value layer in aluminum. Of course, these values are only average values, since the composition of tissue may change considerably under different conditions.

The data given in Table 7 permit calculation of the average *penetration* of w-rays when the quality of radiation has been determined in half-value layers of aluminum, *i. e.*, translation of the half-value layers of aluminum into half value of air, water, muscle, epidermis, cutis vera, and subcutaneous tissue.

TABLE 7

HALF-VALUE LAYER IN ALUMINUM AS COMPARED WITH HALF-VALUE LAYERS IN WATER, MUSCLE, CUTIS VERA, EPIDERMIS, AND SUBCUTANEOUS TISSUE

E. m. f., kv.	Half-value layer.		Muscle, cutis vera, mm.	Half-value layer.	
	Aluminum, mm.	Water, mm.		Epidermis, mm.	Subcutaneous tissue, mm.
4	0.0070	0.12	0.13	0.14	0.20
5	0.0125	0.20	0.22	0.24	0.33
6	0.0175	0.28	0.31	0.34	0.46
8	0.0250	0.39	0.43	0.47	0.64
10	0.0335	0.52	0.57	0.62	0.86
12	0.0400	0.62	0.68	0.74	1.02

Martenstein and Granzow-Irrgang investigated the supersoft radiation from the Mueller tube and found that with an erythema dose the basal-cell layers and papillary bodies of the human skin receive about one half the dose applied to the surface. Below the papillae and in the subpapillary layer there are still evidences of radiation changes. The normal human epidermis varies between 0.07 and 2 mm. in thickness. Bucky has claimed that the penetration of this radiation is small and that 2 mm. of water or of tissue will absorb about 90 per cent of these rays. He has stated that 50 per cent of the in-falling rays are absorbed in the first 0.4 mm. of skin, and at a depth of the sebaceous glands there is about 25 per cent of the original intensity left. In the depth of the hair papillae there remains approximately 1 per cent of the grenz rays. For wavelengths of 2 Å. u. his figures are as follows:

Depth in millimeters.........	0.4	0.8	1.2	1.6	2.0	2.4	2.8
Percentage of surface dose penetrating....................	50%	25%	12.5%	6.3%	3.1%	1.5%	0.7

The *quality* of w-rays at present is measured solely by indirect methods; that is, by means of the kilovoltmeter or the gap between spheres. On account of variations in tubes, it would be advisable, however, to use only the direct quality determination, because attempts to measure the voltage by various other methods, namely, by a kilovoltmeter, a spark gap with needle points, sphere gaps with 5- and 12½-cm. spheres, are unreliable. Sphere-gap readings are the best of these methods, the 5- or 12½-cm. sphere-gap being easily used.

The appended figure is a w-ray spectrum from an iron target at 4, 6, 8, 10 and 12 kv., with the rays filtered through the Lindemann window of 0.2 mm.—which is the average thickness of the windows of w-ray tubes. These curves show that in the range of the shorter waves, intensity rises rapidly and decreases slowly toward the range of the longer wavelengths. The enormous decrease of intensity with the potential can also be read. Of course, these very soft rays are easily absorbed, even by air.

Table 8 illustrates the half-value layer in millimeters of aluminum for various qualities of radiation. Observations were made with a distance of

4 cm. from the window to the chamber and also under the same conditions with a distance of 20 cm. from the window to the chamber, that is, 25.6 cm. from the focus to the chamber.

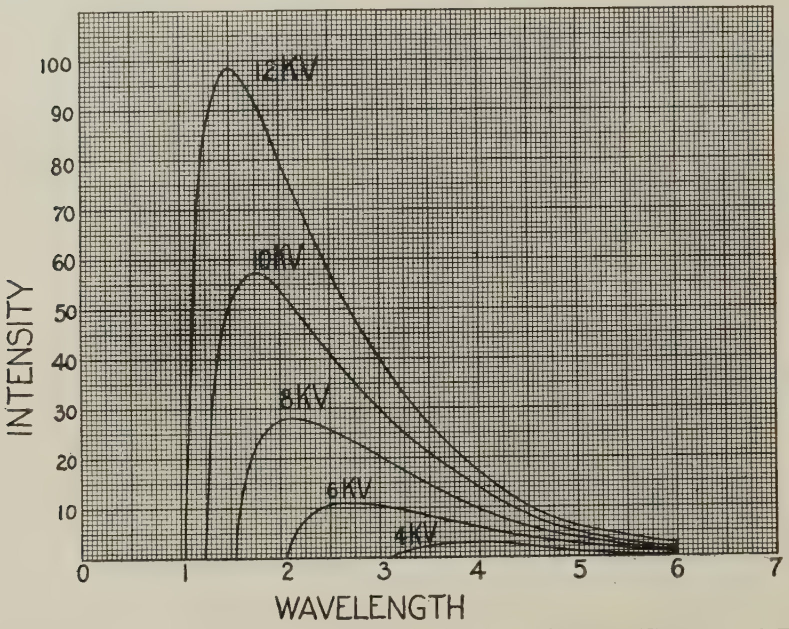

Fig. 102.—Spectrum from an iron target at various voltages. (Courtesy of Dr. Otto Glasser.)

TABLE 8

Half-value Layer in Mm. Aluminum for Grenz Rays; Mueller Tube; Chromium Iron Target; 10 Ma.

E. m. f., kv	Half-value layer in mm. aluminum.	
	4-cm. distance (window chamber), mm.	20-cm. distance (window chamber), mm.
4	0.0070	
5	0.0125	
6	0.0175	0.0195
8	0.0250	0.0315
10	0.0335	0.0435
12	0.0400	0.0601

TABLE 9

Average and Minimum Wavelength of Grenz Rays; Mueller Tube; Chromium Iron Target; 10 Ma.

E. m. f., kv.	Average wavelength in Å.		Minimum wavelength, length in Å.
	4-cm. distance (window chamber).	20-cm. distance (window chamber).	
4	3.0	...	3.0
5	2.5	...	2.5
6	2.2	2.1	2.1
8	1.9	1.8	1.5
10	1.7	1.6	1.2
12	1.6	1.5	1.0

Increased distance "hardens" the bundle of rays according to Roentgen's law of absorption, since the air absorbs the softer components to a greater extent than the harder ones.

The importance of quality determination for the practical use of the w-rays is apparent, and only the direct measurement of the quality at the site of the application of the rays should be accepted, since many factors, particularly the absorption of the rays in the air, play an important rôle in this determination.

A table of half-value layers and average wavelengths for other conditions of radiation therapy may be of interest here (Table 10).

TABLE 10

Half-value Layers and Average Wavelengths for Different Conditions of Radiation Therapy

E. m. f., kv.	Filter.	Half-value layer in mm. aluminum.	Average wavelength in Å.
4	Grenz-ray therapy	0.007	3.0
10		0.0335	1.7
20	....	0.15	1.1
30	....	0.2	0.9
50	skin therapy	0.4	0.8
100		1.0	0.5
130	4 mm. Al. medium therapy	2.0	0.4
130		5.0	0.3
200	0.75 mm. Cu, deep therapy	13.0	0.15

Glasser states that the indirect method of measurement of *quantity* by means of the milliamperemeter has been found to be unsatisfactory. "With decreasing milliamperage the decrease in intensity output is less than it would be proportionately, probably because of an increase in the voltage. It is, therefore, advisable to use the same milliamperage in all investigations. It is far better, however, to measure the quantity of radiation by direct measurements at the point of application."

He has standardized the doses in R-units in exactly the same manner as doses of other qualities of radiation and has found that the threshold erythema dose is in the neighborhood of 250 R-units. Since these rays are easily absorbed in air it is necessary to take special precautions for the determination of the air volume which is irradiated. This is particularly true when a large air chamber is employed because of the comparatively large focus of the tube and the focal distance. A small air-chamber is more suitable in practical therapy, and for such purpose Glasser and Portmann have put into practical use a small chamber (1 cc.), made of goldbeater's skin[1] of 1/100 mm. thickness coated with graphite. Such a chamber may be connected to any practical roentgen-ray dosimeter, and has been shown to measure the intensity of radiation over the range from 5 to 12 kv. independent of the quality. Data upon intensity calculated in R/min. have been determined for a number of conditions.

A study of Table 11 demonstrates the important decrease which occurs in the radiation intensity with increasing focal distance, and resultant absorption of the soft components by the air. The large focus of the tube, the distance itself, as well as the absorption in air, effect a decrease of the intensity such as cannot be calculated by any method, as, for example, by the law of inverse squares.

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[1] Glasser states that satisfactory dosage measurements of these rays have also been made by means of the Wintz-Rump roentgen photometer.

TABLE 11

RADIATION INTENSITIES IN R MIN. AND ERYTHEMA TIMES PER DOSE OF 250 R FOR DIFFERENT DISTANCES; MUELLER TUBE; 10 MA.

Distance in cm. (window chamber).	6-kv. radiation.		10-kv. radiation.	
	R/Min.	Erythema time in min. for 250 R.	R/Min.	Erythema time in min. for 250 R.
4	47.2	5.3	396	0.6
6	27.6	9.0	239	1.0
8	18.2	13.7	162	1.5
10	12.7	19.7	126	2.0
15	5.9	42.3	66.5	3.8
20	3.2	78.0	42.5	5.9

Table 12 illustrates the tremendous decrease of intensity which takes place with decreasing potential, and shows, furthermore, that it seems almost impossible to find an indirect method of dosage measurement, and that in order to make further progress in therapy exact dosage measurements appear to be essential. The values given in the tables offer valuable suggestions as to the influence of distance, potential, and other factors upon dosage of roentgen rays of these wavelengths.

TABLE 12

RADIATION INTENSITIES AND ERYTHEMA TIMES PER DOSE OF 250 R FOR DIFFERENT POTENTIALS; MUELLER TUBE; 10 MA.

E. m. f., kv.	20-cm. distance (window chamber).		4-cm. distance (window chamber).	
	R/Min.	Erythema time in min. for 250 R.	R/Min.	Erythema time in min. for 250 R.
5	0.54	463.0	10.5	23.8
6	3.2	78.0	47.2	5.3
8	16.8	14.9	195.0	1.3
10	42.5	5.9	396.0	0.6
12	98.5	2.5	710.0	0.35

Biological Effects.—Clinically, the mildest form of reaction of the skin to *w*-rays is in a pink erythema, and where there is greater intensity, in a raised, bright red, tender, burning or itching swelling, beyond which the dosage produces blebs, thick impetiginous crusts and superficial ulcerations. The clinical response to these very absorbable *x*-rays is somewhat similar to the reaction to the beta rays of radium. Even after third degree reactions the healing is rapid. The marked pigmentation, which develops during the active period of the reaction, continues to increase until the inflammation subsides, and is pronounced for weeks subsequently. The biological effects of the *w*-rays resemble those of the ordinarily used roentgen rays, producing an erythema, pigmentation, and superficial destruction if the dose is sufficiently large. The erythema following the supersoft roentgen rays may rarely be delayed for three or four weeks in appearance due to individual idiosyncrasy. Repeated doses tend to accumulate if sufficiently large and at frequent intervals.

In patients I have treated there has been a cumulative effect from erythema doses given weekly.

The biological effects of the *w*-rays differ from those of the usual *x*-rays in that after large doses of the former the erythema may appear in a few moments, whereas with the latter, even in large doses, there will be an interval of at least three days before its appearance. Because of the small residue of the beam which penetrates to the depth of the hair follicles, epilation does not follow even the largest exposures of *w*-rays used in therapy. The sequelae (namely, atrophy and telangiectasia) which occur after intensive doses of *x*-rays of ordinary wavelength are observed less often after large doses of *w*-rays. Sequelae following supersoft roentgen-ray therapy with wavelengths of 2 Å. u. are so infrequent that for practical purposes the danger after sub-erythema doses or one erythema dose may cause little concern. However, repeated severe reactions will be followed by atrophy and telangiectasia. Therefore, it is wise to avoid reactions except in the treatment of carcinoma, or small circumscribed lesions such as warts.

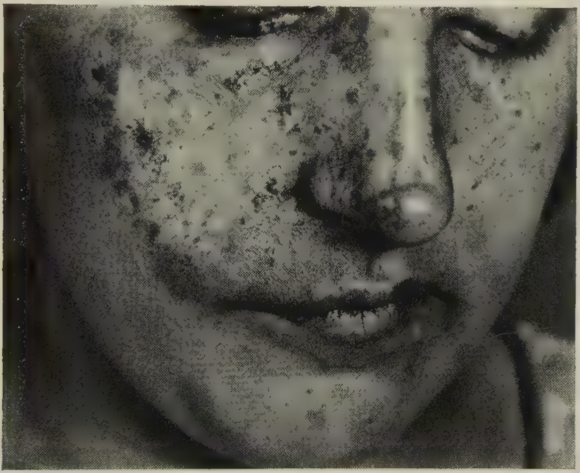

Fig. 103.—Atrophy and telangiectasia due to repeated intensive doses of grenz rays, always with less than 10 kv.

According to Bucky, there seems to be an important distinction between the effects of soft *x*-rays generated by 15 kv. or more and those generated by less than 10 kv. in regard to sequelae. All of the earlier work with soft roentgen radiation was at the higher voltages and was followed by atrophy and telangiectasia, whereas the recent experiments with very absorbable rays produced by a kilovoltage of 10 or less have entailed relatively few sequelae. Presumably the danger of telangiectasia is greater beyond 10 kv.

Bucky has demonstrated that exposure to wavelengths between 2.19 and 1.44 Å. u. produced by 6 to 12 kv. causes a decrease in the peripheral leukocytes, and this was construed to mean that the rays exert an action upon the autonomic nervous system in the skin. Giving 1/20 E. D. to an area of skin 1 sq. cm., he produced a temporary leukocyte drop of 20 to 30 per cent in about twenty minutes and a return to normal in about one hour. Mueller and Peterson[1] found that with the drop in the leukocyte count in the skin an increased permeability of the splanchnic vessels takes place and that the leukocytes are not destroyed but are only removed from the skin to the liver. Gabriel and others have produced the same effects with roentgen rays of ordinary wavelength so that there is nothing in this reaction which is not characteristic of roentgen radiation in general.

Histology.—Microscopically, Rothmann found changes in the skin a few hours after erythema doses of *w*-rays and these remained visible for several months. The effects of the rays were noted in all layers of the epidermis, and in the vessels of the corium, and with large doses, also in the follicles and upper cutis, where the connective tissue was swollen. The sebaceous and sweat glands do not show any structural alterations; slight swelling of the cells was visible only after the largest doses. The epidermal changes consist of edema of the cells and nuclei, vacuolation, and contraction of the nuclei. There were always vessel changes in the corium, swelling of the endothelium, great alterations in the adventitial cells, and perivascular cell infiltration, chiefly lymphocytes. When large doses are used, there is infiltration around the sebaceous glands and hair follicles. For three months after irradiation there are still changes in the superficial vessels of the corium and an intense pigment deposit in the basal cells. A histologic comparison between *w*-ray and roentgen-ray erythema shows that they are strikingly alike qualitatively.

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[1] Quoted by Bucky: Am. J. Roentgenol., 17: 647, June, 1927.

Technic and Dosage.—In spite of the general impression that the *w*-rays are harmless, there is no doubt that after intensive doses of them roentgen sequelae may appear, even though the kilovoltage has never exceeded the arbitrary figure (8 kv.) set up by Bucky as the safety limit. The clinical application of *w*-rays is attended by hazards similar to those entailed by the use of the beta rays from radium.

The technic of *w*-ray therapy is still only slightly developed. It is generally conceded that the voltage should be less than 10 kv., 8 kv. being commonly used. With this voltage, 8 ma. and an exposure time of four to six minutes suffice to produce an erythema at 6-cm. distance from the center of the anode. The figures given above are for an average erythema dose, which provokes a moderate redness within twenty-four hours. The reaction varies according to the patient's age, complexion, and the site of the area treated, as well as other factors which have been mentioned on page 133, Chapter VI.

The construction of the apparatus and especially the small size of the tube and the Lindemann glass window limit the method of application to approximately the above technic except the time factor, which is most variable. Owing to the small distance from the target to the window, the angle of incidence of the radiation upon all but the central portion of the window is much less than a right angle, so that the bundle spreads rapidly with small increases in the distance between the anode and the irradiated skin surface. For this reason, although the Lindemann glass window is small, relatively large fields may be radiated with a small anode-skin distance. Fuhs has determined areas of the following sizes as being irradiated with a fairly uniform intensity at the given distances from the window, employing a fluoroscopic screen in a darkened room for these experiments. The diameter of the irradiated field is

10	15	20	25	30 cm.	at about
8	12	14	16	18 cm.	distance from the window

As previously stated, increase of distance "hardens" the bundle of rays due to the absorption of the softer components by the air. This fact must be taken into consideration in changes of distance. I have found no objection to making the anode-skin distance as small as compatible with the circumstances of the individual case. Rarely are distances greater than 6 cm. advisable, the diameter of the field of uniform intensity at this distance being about 7 cm.

The limited variations permitted in voltage, milliamperage, and distance cause us to rely mostly upon time as a means of regulating dosage. Whereas four to six minutes will produce an erythema, with the customary factors, exposures of thirty to forty minutes frequently are within the therapeutic range. Two, three, or four times the erythema dose weekly are sometimes required to obtain satisfactory therapeutic results, although one to two erythema doses are sufficient for most diseases. It is not always necessary, however, to produce an erythema with the w-rays to exert beneficial action. Suberythema and fractional doses regularly cause some improvement in certain skin diseases, which, nevertheless, respond more readily to fractional dosage of ordinary roentgen rays. In this group may be mentioned eczema, dermatitis seborrhoeica, and neurodermatitis. I have slowly caused complete disappearance of these dermatoses by suberythema doses of supersoft rays without other treatment, but when fractional doses are to be effective they should be repeated weekly.

Skin previously irradiated with the ordinary x-rays is markedly influenced by fractional doses of supersoft x-rays. Very decided reactions are provoked by fractional doses of w-rays in skin which has received only a few small doses of ordinary x-rays and vice versa.

Therapeutical Value.—The absorption of the w-rays is concentrated to such an extent in the uppermost layers of the skin that this form of radiotherapy has special value and adaptation to the treatment of superficial dermatoses in which it is desirable to avoid effects below the papillary layer of the derma—diseases of the scalp, eyelids, eyebrows, and scrotum. Dermatitis sedorrhoeica, psoriasis, eczema, pruritus, and neurodermatitis of these regions are the chief affections treated by the w-rays, preferably by fractional suberythema doses.

Favorable results also have been achieved on these and other areas in dermatoses which respond to ordinary radiotherapy, especially in keratoses, leukoplakia, verrucae, and superficial types of basal-cell epithelioma, particularly on the eyelids and cartilaginous portions of the nose and auricles where deep radiation effects are undesirable. The action in the treatment of these latter diseases and in the hypertrophic type of lichen planus is similar to that of the beta rays of radium, producing an intense superficial caustic reaction, which heals with practically no sequelae; and the dosage must be large to obtain good results, ranging from five to ten times the erythema dose. Lupus erythematosus has at times been benefited by 2 or 3 E. D., but recurrences have almost invariably been manifest at the edges, and the treatment has in my hands been less satisfactory than other methods. In the treatment of dermatophytosis, perlèche, pruritus, psoriasis, and lichen planus, smaller doses are given, but they usually must be sufficient to produce a skin reaction in order to cause satisfactory improvement. This reaction is objectionable because it is unsightly, uncomfortable, and often followed by hyperpigmentation (and sometimes by telangiectasias), for which reasons treatment by fractional suberythema doses of ordinary wavelength is preferable to w-ray therapy in most dermatoses which are radiosensitive and not located on the scalp, the lids or the scrotum.

Occasionally improvement has followed the application of w-rays on the lesions of acne vulgaris, acne keloid, angioma cavernosum, dermatitis herpetiformis, keloid, sycosis vulgaris and tinea capitis, but the results have been far inferior to those from ordinary wavelengths of x-rays. I have tried the w-rays on many other dermatoses without success.

In the treatment of dermatitis seborrhoeica, eczema, pruritus, lichenification, and psoriasis of the areas just mentioned, half-strength radium applicators may be used as effectively and with very little more exposure time, inconvenience or expense than necessary for proper w-ray therapy. However, the likelihood of sequelae from unfiltered flat glazed radium applicators is apparently a little greater than from w-rays, so there is slightly more danger from intensive exposures of the former than from equivalent doses of the latter. For the treatment of keratoses, warts, and superficial epithelioma, unfiltered radium rays from flat applicators, or a glass tube or bulb are far more adaptable, dynamic, rapid, and accurate than w-ray therapy in its present state of development, and sequelae do not often follow the use of therapeutical doses of unfiltered radium on such small areas. Even in the diseases in which the effects of w-rays are satisfactory, the small field irradiated by present apparatus is a disadvantage.

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CHAPTER VIII

RADIUM THERAPY

It is not within the scope of this book to consider the physical nature of radium and radon and their relations to each other in greater detail than is essential to a clear understanding of their therapeutic application. The literature upon radioactivity is abundant and the reader is referred to the bibliography for more comprehensive information.

Radioactivity—Radium, Radon.—Radioactivity is the outward evidence of spontaneous disintegration of a radioactive substance, or transmutation of the element, atom by atom, into other substances. An element is therefore radioactive when it undergoes spontaneous disintegration and transmutation. Such elements possess distinctive powers, in varying degrees, to affect photographic emulsions, generate heat, produce phosphorescence and fluorescence in certain substances, and to cause air and other gases through ionization to become partial conductors of electricity. In a single transformation one or more rays are emitted, the resultant product being another element, of lower atomic weight, and differing from the parent in both physical and chemical properties.

Radium in the elemental state is a solid grayish-white metal belonging in the alkaline earth family. The chemistry of radium is similar to that of barium. Metallic radium has been rarely prepared because of its avidity to react to form stable salts. These salts are more suitable for general use. The common salts of radium are the chloride, bromide, carbonate and sulphate; the latter being the salt usually employed in therapeutic applicators on account of its stability and small volume per unit of contained radium element. Preparations of the salts are spoken of in terms of metallic (element) radium content, owing to the fact that the strength is proportional to it regardless of the chemical combination of the radium.

Radium with an atomic weight of 226 emits an alpha ray or, more specifically, a particle of matter carrying two positive charges. This alpha particle upon the loss of its positive charge is an atom of helium with an atomic weight of 4. The residue, a gas, is a new element called radon,[1] having an atomic weight of 222. Radon undergoes a similar change giving off an alpha particle, atomic weight 4, which leaves as a residue a metal RaA, atomic weight 218. Radium A likewise disintegrates, emitting an alpha particle, and producing another new metallic element RaB, atomic weight 214. Radium B transforms by the emission of beta rays (negative electrons from the outer shell of the atom) into a new element called RaC, but without reduction of the atomic weight. These beta rays, in their rapid escape from the radium B atom, produce vibrations of other electrons causing the projection of high frequency electromagnetic waves called gamma rays, which are analogous to x-rays, ultraviolet, and visible light. They are, however, of much higher frequency (300 billion billion cycles), of a much shorter wavelength (1.4–0.01 Å. u.) and consequently more penetrating. Radium C undergoes radioactive transformation forming RaC_2 and producing beta and gamma rays of the shortest wavelengths, known as hard beta and hard gamma rays, the most penetrating of their kind. For therapeutic purposes the beta and gamma rays are used, and these are derived from RaB, RaC, and RaC_2.

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[1] Radon is the name suggested in 1923 by the International Committee on Chemical Elements to be used in place of the term "radium emanation."

Radioactive transformations take place spontaneously and unalterably follow definite courses as to time required and products formed. The decay or disintegration of a radioactive element is half completed in a definite interval known as the "half-decay period." In a lapse of twice this time only one quarter of the original remains. Thus, in each "half-decay period" half of the previous remainder has disintegrated. Mathematically, all of the original would not be disintegrated, but for practical purposes ten times the "half-decay period" will be the total life or the time when all of the original will have decayed. Half-decay periods for a given element are constant, but with the different radioactive elements they vary from a fraction of a second to thousands of years. Radium in approximately 17,000 years becomes completely transformed into lead having an atomic weight of 206.

The following data[1] illustrate the changes which occur in the radium series; the atomic weight of each element, its half-time value, and its emitted radiation being given in brackets: Radium (226; 1690 years, alpha) ⟶ Radon (222; 3.85 days, alpha) ⟶ Radium A (218; three minutes, alpha) ⟶ Radium B (214; 26.8 minutes, beta and gamma) ⟶ Radium C (214; 19.5 minutes, alpha, beta, and gamma) ⟶ and so on until the end product is reached, Radium omega, lead (206, atoms stable, no radiation emitted).

The alpha, beta, and gamma rays differ widely in their characteristics. The *alpha particles* are positively charged. Although active ionizers, they are of negligible therapeutic value because of their low penetrability, being absorbed by a sheet of writing paper. They act upon living tissues when radium solutions are injected intravenously, but such procedure is seldom employed because of its danger. The *beta rays* are negatively charged electrons of various velocities, to which their powers of penetration are proportionate. They are about one hundred times more penetrating than the alpha rays, probably reaching a depth of 1 to 3 cm. in tissue. The swiftest beta particles approximate the velocity of light, and are known as the hard beta rays. The slower beta rays, which have far less penetrative power, are called "soft" beta rays. Colwell and Russ determined that the intensity of the "hard" beta rays is reduced to about 6 per cent of their initial value after passing through 1 cm. of epithelial tissue. Beta rays are wholly absorbed by 1 mm. of lead or 4 mm. of aluminum, and are one half absorbed in 1 mm. of soft tissue. Beta radiation is of greatest value in the treatment of very superficial skin diseases, which usually are of the benign or precancerous type. The *gamma rays* are unlike the alpha and beta rays inasmuch as they are ether vibrations of different short wavelengths similar to light. The gamma rays possess marked powers of penetration. Like other electromagnetic waves, they are electrically neither positive nor negative; being sometimes called neutral. They are about one hundred times as penetrating as the beta rays, and carry the energy from radium into the deeper tissues as far as 6 to 8 inches. Lead 10 or more cm. thick is required to absorb the gamma rays completely, whereas the beta rays are screened off by 1.1 mm. of lead. According to their power of penetration, there are "soft" and "hard" beta and gamma rays.

For therapeutic purposes the energy output of radium is composed of 4.8

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[1] Simpson, F. E., Radium Therapy, 1922, page 19.

per cent gamma radiation, 3.2 per cent beta radiation, and 92 per cent alpha radiation, the latter not being utilized.[1] Expressed in calories of heat per hour, the amounts of energy in the three forms of rays from 1 Gm. of radium in equilibrium with emanation, radium A, B, and C, were given by Viol as follows: Alpha rays 123, beta rays 4.3, and gamma rays 6.5. From this it is evident that the beta and gamma rays carry about the same total amounts of energy, although differing greatly in powers of penetration.

Radium preparations are evaluated and radium content measured by comparison of the intensity of hard gamma rays emitted by them with the intensity of hard gamma rays emitted by a standard of known radium content. Obviously the purity of a preparation would have some influence on the intensity of emitted radiation. Most radium salts in use today are of a purity approaching 95 to 99 per cent, so the matter of self-absorption of radiation is of small moment. This, however, was not true in the early days when purities of the order of 10 per cent were employed.

The unit of measurement of radium is the milligram. The millicurie is the practical unit of emanation (radon) measurement. It is defined as that quantity of aged radon (sealed for four hours or more) which emits the same intensity of hard gamma rays as 1 mg. of aged radium. The latter is in equilibrium with its immediate decay product, radon, this adjustment being sensibly complete in forty days after the radium has been hermetically sealed. One millicurie of radon therefore possesses radioactive intensity equivalent to that of a milligram of radium element. The millicurie is subdivided into the microcurie, which is the thousandth part of it. From the above definition and the data given earlier, it is pointed out that, while we speak of using radium and radon therapeutically, neither is actually so employed except as more or less stable sources of the short lived RaB, RaC, and RaC_2, which actually emit the rays utilized.

Radium provides a practically constant beta and gamma radiation for years since its "half-decay period" is 1690 years, which means a diminution of about 1 per cent in twenty-five years; whereas radon has a "half-decay period" of 3.85 days and is completely dissipated in about forty days. In the case of radon, the gamma ray intensity rises to a maximum in four hours after separation from its parent radium and then declines at a rate of 16.47 per cent every twenty-four hours, dropping to one half of the maximum value in 3.85 days. As stated, the rate of decay of the gamma ray intensity of a radon preparation is unalterable and definite, so that if the value is known for any given hour on any day, its subsequent strength can be ascertained. One millicurie, if applied for its life, delivers a total of 133 millicurie hours, 50 per cent of which is delivered in the first 3.85 days.

Radon can be placed in tubes 1/100 the size of those required for the equivalent radiation intensity of radium salt. This property makes possible small applicators of high activity and lends itself admirably to the making of applicators of various shapes and sizes suitable for individual cases, which flexibility and small compass are impossible when radium salts are used. Radon may be placed in capillary tubes of gold or glass for insertion directly into tumor tissue. It offers a further advantage in that should an applicator be lost, its monetary value is very small compared with its equivalence in radium salt.

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[1] Degrais, P.: Beta Rays of Radium, Presse méd., 31: 141–152, Feb. 14, 1923, Ab. J. A. M. A., 80: 1653, June 2, 1923.

One of the earliest uses of radon was in radioactive water. The waters of well-known spas possess slight radioactive properties. No direct connection has really been established between the radium emanation in the springs and the physiologic changes. Simpson points out that the definite biological effects which follow the therapeutic administration of radium emanation or radium salts are due to quantities several million times greater than are found in any known natural spring.

In the decay of radon through the series of disintegration products, a deposit which is known as the *active deposit* (RaA, RaB, RaC, and RaC_2) forms on the walls of the sealed container. This substance may be collected upon small pieces of lead-foil and used for extremely superficial therapeutic effects, being principally employed in the treatment of vernal catarrh and trachoma. Its use is limited by the dangers encountered in its production, and because its life is even shorter than that of radon.

The active deposit is also used for injection, being prepared in physiologic salt solution. It has been given intravenously in the leukemias, lymphosarcoma, and Hodgkin's disease and has been injected directly into neoplasms.

Kotzareff and Weyl have employed intravenous injections of the active deposit dissolved in autoserum for the early detection of neoplasms and metastases whose location renders them difficult of clinical study. There seems to be an elective fixation of the radioactive substances by embryonic or neoplastic cells, which effect is reproduced upon photographic plates. However, Martland has condemned the intravenous injection of radioactive substances as distinctly dangerous on account of their cumulative effects, basing his opinion upon 15 fatal cases of mesothorium poisoning. The radioactive substance was ingested by girls who applied luminous paint to watch dials, using a small brush which they wet with their lips.

Distribution.—As only the absorbed energy can exert biological action, accurate *approximation* of the radium to the lesion is imperative. The optimal usefulness of radium is limited to a short radius, and its effects depend largely upon the accessibility of its emitted energy to the cells. Skin lesions are so readily accessible that one of the most serious handicaps in the use of radium for the treatment of malignant disease is overcome at the outset.

Superficial radium therapy deals with lesions not much more than 1 cm. in depth from the body surface, suitable for treatment by unfiltered or lightly filtered apparatus which permits the passage of a preponderant beta radiation.[1] The quality and quantity of energy reaching the lesion are the salient factors, and not the amount in the source. Since the beta rays are absorbed much more readily than the gamma rays they affect principally the superficial layers of tissue, while the gamma rays penetrate and produce effects at greater depth. *Penetration* is indispensible in the treatment of subcutaneous pathologic processes, but it is not needed so greatly in cutaneous lesions unless they are thickened. In deep-seated lesions, the penetrative qualities of the gamma rays are essential, and in order to avoid excessive superficial destruction by the beta rays the latter must be absorbed in suitable metal screens. *Screening* (filtration) is afforded by interposing various metals or other substances known as screens between the radioactive source and the skin, thus relieving the latter from the absorption of much soft radiation and subjecting it to a minimum amount of injury when subcutaneous or deep structures are under treatment. Screening, then, serves the general purpose of absorbing undesirable types of radiations before they can be absorbed in the tissues, thus preventing excessive injury to the superficial layers of the skin. The indications for screening in radium therapy are regulated to a large degree by the size, location, and character of the pathologic condition. The employment of screens introduces the additional factors of secondary radiation generated in the filtering material, and of loss of intensity through increased distance due to its thickness.

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[1] The term "unfiltered radiation" is applied throughout to radium salt or radon contained in a thin capillary glass tube or bulb, or the salt on the surface of a flat applicator, where it is held in place by glaze. The only radiation used which is strictly unfiltered is the active deposit.

Screens are usually made of brass, silver, aluminum or platinum, and occasionally of lead and gold. As the secondary radiation from these metals may result in undesirable superficial irritation upon the skin, it is advisable to insert, between these screens and the skin, further absorptive materials, nonmetallic or of low density, such as sheet-rubber, chamois, wood, gauze, or filter paper. When only gamma radiation is desired, a primary filter of 2 mm. of brass and a secondary filter of 2 mm. gum rubber or an equivalent combination of other materials should be used. Brass produces little secondary radiation and should be used whenever distance and space permit. Other filtrations are preferred by some workers. While theoretically screens of almost any material or thickness may be employed, it is found advisable in actual practice to use a few different screens of suitable densities in order to simplify the technic. One can calculate the thickness of different materials which is required to absorb a given amount of radiation by comparing their relative densities with metals of known absorption values. A general rule, which holds with sufficient accuracy for all purposes, is that the absorbing power of metals for a given type of beta or gamma radiation increases in proportion to the density of the metals. A table giving the approximate absorption coefficients of substances commonly used for filtration in dermatological therapy was kindly supplied by Dr. Viol (Table 13).

TABLE 13

PERCENTAGE OF HARD BETA RAYS ABSORBED BY SCREEN

Thickness of screen in mm.	Aluminum.	Silver.	Brass.	Lead.
0.1	15	50.0	37.0	50.0
0.2	29	75.0	60.0	75.0
0.3	40	87.5	75.0	87.5
0.4	50	93.7	84.0	93.7
0.5	58	96.8	90.0	96.8
0.6	64	98.4	93.7	98.4
0.7	70	99.2	96.0	99.2
0.8	75	99.6	97.3	99.6
0.9	79	99.8	98.4	99.8
1.0	82	99.9	99.0	99.9

The absorption power of lead is approximately the same as that of silver. The percentages for aluminum are based on the half absorption value of 0.4 mm. and for brass on 0.15 mm. For practical purposes 0.5 mm. of platinum or gold is equivalent to 0.9 mm. of lead, 1.1 mm. of silver, and 2 mm. of brass when a secondary filter of gum rubber is added to each. The combination of 0.5 mm. of silver, 1 mm. of brass and 2 mm. of rubber is also equivalent to the above. It must be borne in mind that the so-called hard beta rays are not homogeneous and as more and more of the radiation is absorbed, the residue which penetrates the screen, in general, will be of a more penetrating quality. The figures given, however, are sufficiently accurate.

Pinch gives the percentage transmission of beta and hard gamma radiation by screens that he generally uses, as shown in Table 14:

TABLE 14

Screen.	Thickness in mm.	Percentage transmitted.	
		Beta.	Gamma.
Aluminum	0.01	96.3	99.99
Lead	0.1	23.6	99.6
Platinum	0.3	2.28	99.2
Silver	0.5	3.98	97.1
Silver	1.0	1.18	95.5

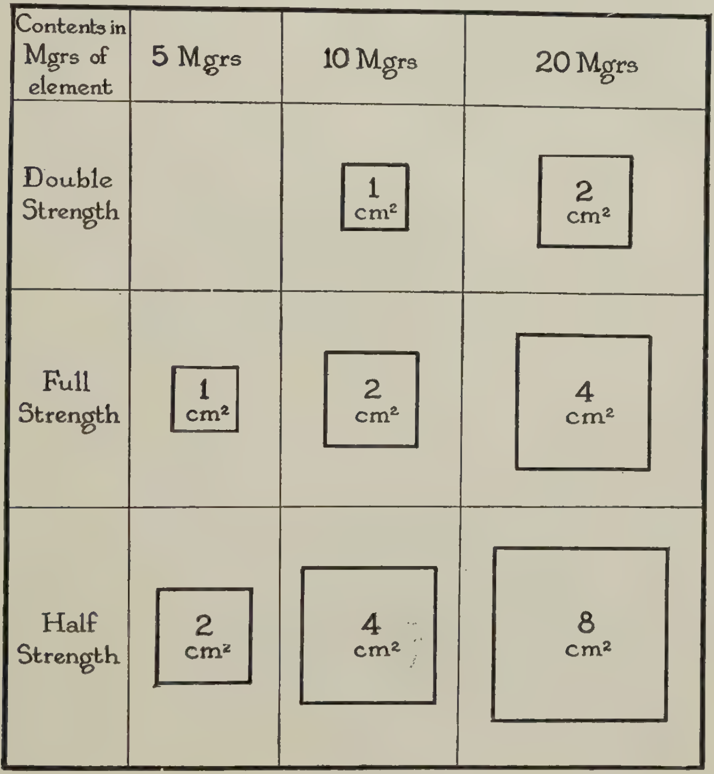
Quimby has tabulated the absorption of beta and gamma radiations in several metals commonly used as screens (silver, lead, brass, copper, platinum, and gold), absorption curves for each being first obtained. A thin strip of known thickness of each metal was exposed over a slit in a piece of brass 1 cm. thick to radium emanation in a capillary glass tube, and the radiation which passed through the metal was measured in an ionization chamber. Measurements were first made for the combined beta and gamma radiation, and then the beta radiation was deflected by a magnet and measurements were made of the gamma radiation alone. The procedure was repeated for various thicknesses of the metals tested until curves could be plotted for the absorption in the metal of the total radiation from the emanation tube, and of the gamma radiation alone. A similar method was followed for the determination of the absorption in tissue substitute (rubber) of the radiation transmitted by any screen.

These facts have been correlated with biological information obtained from numerous skin tests, with a threshold erythema as an indicator. From this, Quimby has worked out an empirical relation between ionization measurements and skin doses for radiation delivered by various metallic screens. Calculations made within the range covered by the experiments are sufficiently accurate for the practical determination of the erythema dose for screens of different materials and thicknesses.

Types of Applicators.—In the treatment of some superficial dermatoses, including keratoses, verrucae, and some types of angioma, leukoplakia and epithelioma, it is desirable to have a radium applicator which permits the use of the beta radiations and gives a uniform effect on a superficial lesion. This purpose is accomplished by the *flat glazed applicator*, which is made by fusing upon a sheet-silver back, approximately 3 mm. thick, a layer of glaze about 0.3 mm. thick containing radium sulphate. Such salt applicators have one advantage over radon applicators in that their strength is sensibly constant for years. The "strength" of the flat applicator is governed by the amount of radium per square centimeter of surface, while the total area and strength determine its radium content. Full strength is denoted by 5 mg. of radium per square centimeter; double-strength and half-strength applicators are measured accordingly. A full-strength applicator containing 5 mg. of radium has a surface dimension of 1 × 1 cm.; containing 10 mg., a dimension of 1.4 × 1.4 cm.; containing 20 mg., a dimension of 2 × 2 cm. Flat applicators may be made in any shape. The square shape is recommended because with it a large area such as that of an angioma may be radiated in sections without overlapping. Round or oval shapes are suited for small lesions, upon which they may often be used without shielding.

The flat glazed applicator is popular among dermatologists, because a small amount of radium in this form permits the use of the soft beta rays and, with suitable screening, the more penetrating effects of hard beta or gamma rays. Screening is applied to flat applicators ordinarily by the use of screens of aluminum, silver, lead, or brass. By the insertion of these, varied proportions of beta radiation may be filtered out.

A special type of round, flat applicator, 1 cm. in diameter, has been described by Beers. The surface is covered with monel metal, which is approximately equivalent to a filtration of 0.1 mm. of aluminum, and from its back a lug projects to facilitate attachment to a handle. This applicator, containing 10 to 20 mg. of radium salt, has a wide field of service in the handling of very small lesions.



Contents in Mgrs of element	5 Mgrs	10 Mgrs	20 Mgrs
Double Strength		1 cm²	2 cm²
Full Strength	1 cm²	2 cm²	4 cm²
Half Strength	2 cm²	4 cm²	8 cm²

Fig. 104.

For superficial intense soft radiation effects a *bare emanation tube plaque* has a wide range of usefulness. This plaque consists of a block of wood, 2 cm. square, backed by a sheet of lead, at least 2 mm. thick, for protection of the operator. Glass capillary tubes containing radon are evenly distributed over the surface of the wood, to which they are attached by paraffin. The distribution of the tubes is such as to deliver a uniformly intense dosage over the skin surface of an area equal to its own dimensions, that is, 4 square cm. The plaque is applied "domino fashion" with a space of at least 2 mm. between each area of application in order to avoid overlapping, which would result in certain skin areas receiving an overdose. The *bulb*, described by Quick, has a similar applicability to small superficial skin lesions, where accuracy is enhanced by holding the radium in place by hand while the treatment is being given.

At the Memorial Hospital "about 600 mc. of radon is collected in a small thin glass bulb 5 mm. in diameter. The bulb is then sealed with paraffin in the end of a steel cone just large enough to receive it and permit of complete inclusion. The steel cone has attached at its apex a pliable metal rod about 45 cm. in length which permits the operator to keep a reasonable distance from the emanation. The pliable material permits bending to facilitate applications in various locations. It will be seen that the bulb of radium emanation occupies the same position in the cone that a clapper does in a bell. At the base of the cone it is exposed and unfiltered, while in all other directions it is filtered by the steel jacket.

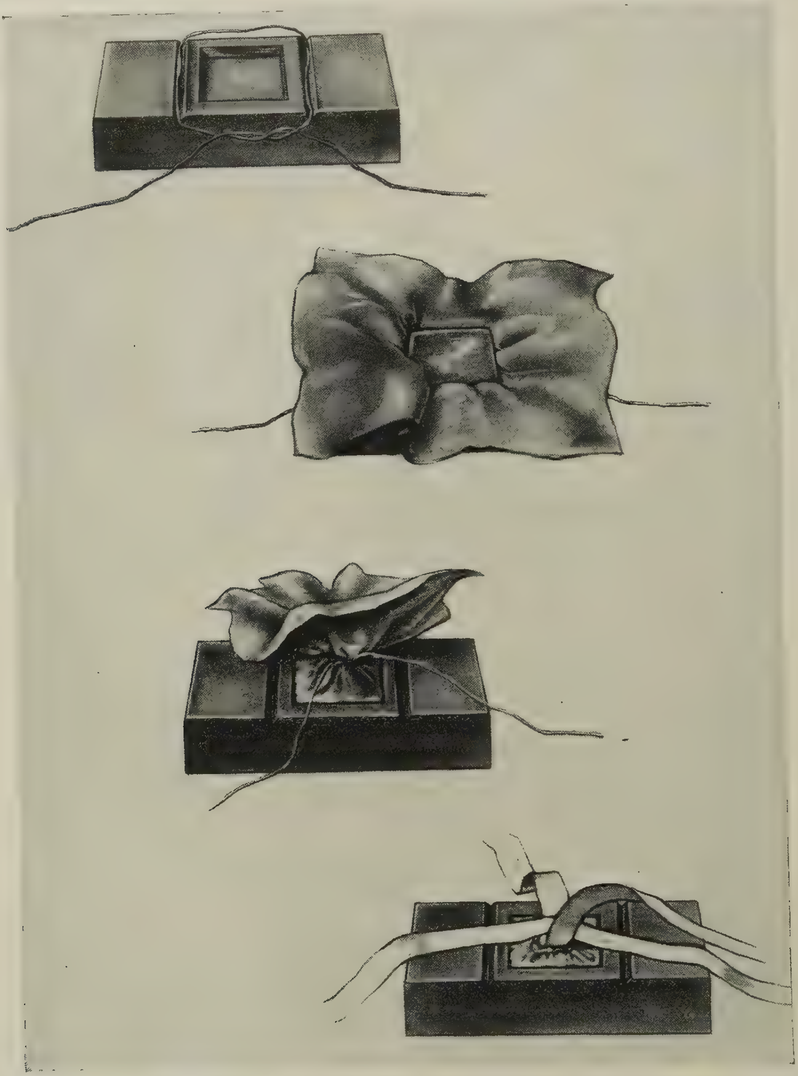


Fig. 105.—Cameron brass holder for flat applicator which makes it possible to attach a filter and to cover the plaque with oil silk without exposing the fingers.

In order to lend further filtration for certain cases another cone made of 2 mm. of brass with a 1-mm. brass cap to fit over the base of the cone has been constructed. . . . Since the radiation is from a flattened spherical surface, it is better adapted to these small lesions than a tube of radium which gives an oval field of radiation. Being unfiltered, both beta and gamma radiations are utilized, resulting in a saving of radioactivity, and, since the radiation is softer, the reaction is not so deep, and healing is much more prompt."[1]

[1] Quick, D.: A New Type of Applicator for Use with Radium Emanation, Am. J. Roentgenol., 9: 53–55, Jan., 1922.

This method is of special value in the treatment of lesions in difficult locations, about the edges of the eyelids, at the inner canthus, or on the conjunctiva, where accuracy of application is the all-important feature.

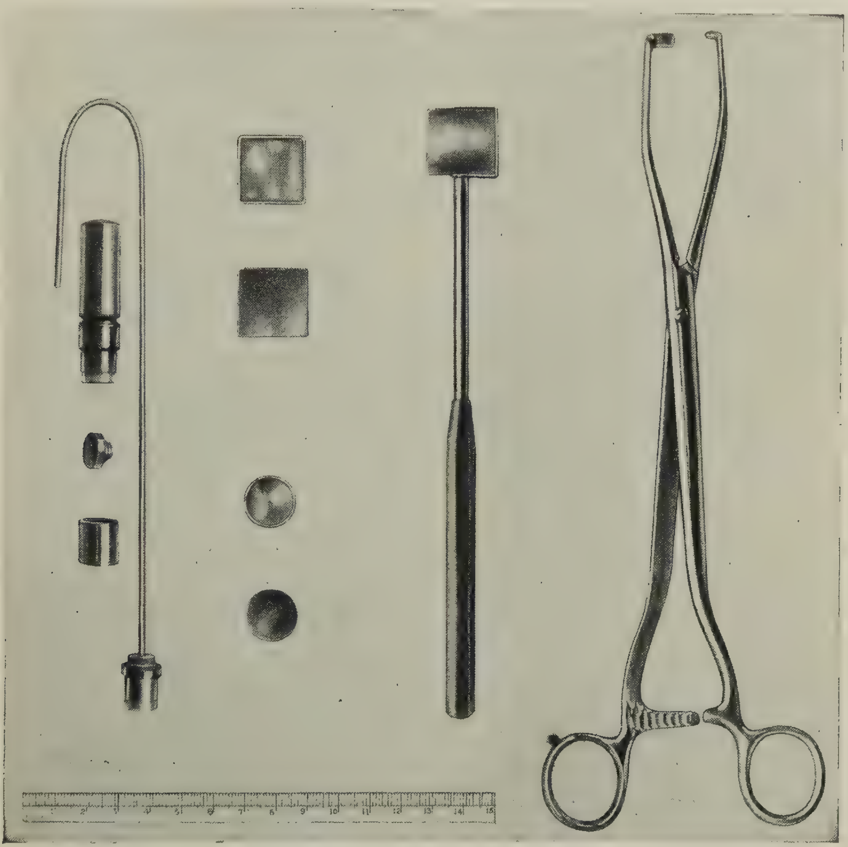


Fig. 106.—Various kinds of flat glazed applicators and holders for them.

Tubes of various sizes and materials are also used as containers of the salt or emanation. They may be employed upon the surface, inserted into cavities, or implanted interstitially.

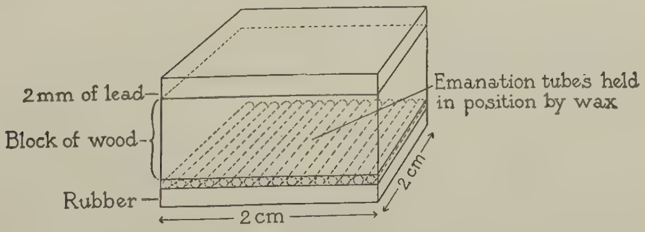


Fig. 107.—Bare emanation tube plaque.

Tubes containing the salt are made of capillary glass and inserted into silver tubular containers. These in turn may be placed within other metal containers for increased filtration. These tubes usually contain 5 or 10, 25 or 50 mg. of radium as sulphate, although the amount is sometimes as high as 100 mg. per tube.

Emanation tubes are used mainly as follows:

1. Five-tenth mm. silver wall tubes containing glass emanation tubes about 0.6 mm. in diameter and 10 to 15 mm. in length, are evenly distributed within the substance of a mold of plastic substance—usually nonmetallic filled dental modeling compound—conforming to the shape and size of the lesion.

2. Many of the same silver emanation tubes are arranged in grooves in the floor of square or circular brass boxes or trays, and held in this position by paraffin. The floor is of desired thickness, so that the total filtration of the silver wall of the tube and the brass floor is the equivalent of 2 mm. of brass. These flat applicators or plaques are used at a distance.

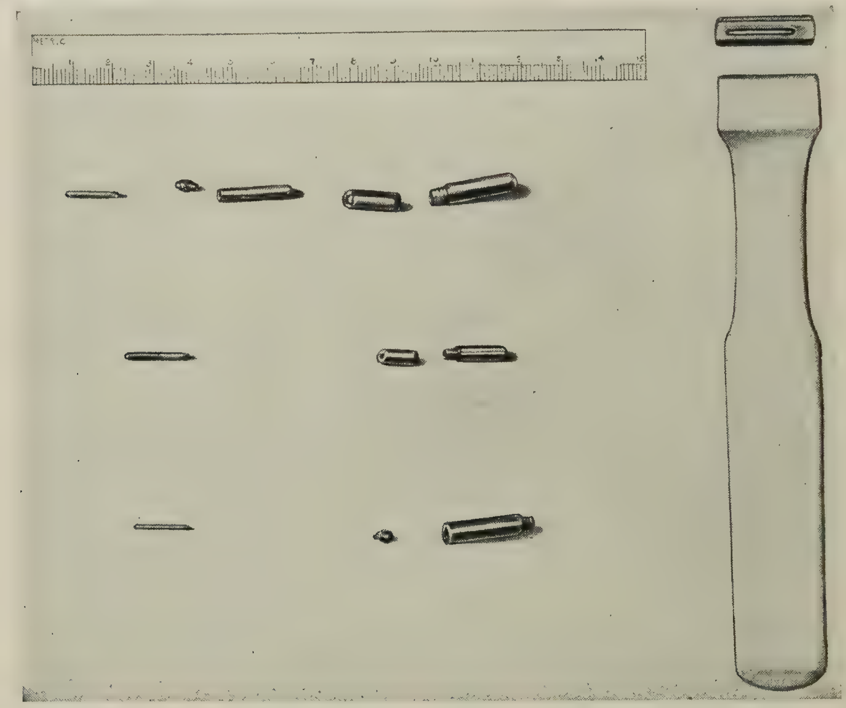


Fig. 108.—Glass, silver, brass, and lead tubes. At the right is a wooden holder for a bare emanation tube, which is placed in a groove at one end of it and fixed by paraffin.

3. Unfiltered glass emanation tubes are fastened closely together upon the end of a wooden spatula, so that the resulting applicator may be substituted for the "bulb."

4. Radon is placed in small glass tubes, 3 to 4 mm. in length and 0.3 mm. in diameter, called "bare seeds"—"glass implants"—and is used interstitially, without any metal screening, by embedding it in the lesion and leaving it *in situ*.

5. Radon in small pure gold tubes (gold implants) of 3 to 5 mm. length and 0.55 to 0.75 mm. diameter and with a wall thickness of 0.2 or 0.3 mm., is similarly implanted in the lesion. This filtration largely absorbs the hard beta rays so that practically only gamma radiation is given off.[1]

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[1] Failla, G.: The Development of Filtered Radon Implants, Am. J. Roentgenol., 16: 512, Dec., 1926.

6. Radon in removable platinum implants is used in the same way as gold, but mechanically presents a number of points of difference.

Inasmuch as the removable platinum implant consists of a glass capillary tube encased in 0.4 mm. thickness of platinum, it is larger than the gold implant by the amount of 0.4 mm. in all its dimensions. Yet it remains so minute as to be readily applicable in any situation where either of the other types of implants can be placed, and it has some advantages over either of the other types. The gold capillary tube into which radon is directly placed, is sealed off into lengths suitable for implantation by pinching with pliers, the cutting edges of which have been considerably dulled. If the metal so compressed is flawless, this makes a gas-tight seal. Should there be any imperfection at the point of joining, leakage of radon may occur. As both the enclosed glass tube and its platinum container can be more firmly sealed against leakage, this danger is obviated. The pinching off of the gold implants leaves the ends more or less rough and uneven, so that their insertion may cause trauma; the platinum seeds, on the contrary, are smooth and rounded, so that trauma is minimal. Their chief advantage over other varieties of implants consists in the fact that they are removable. Both the bare tubes and the gold implants when once placed in the tissues must remain there. There is no way in which they can be recovered. The platinum seeds are equipped with an attached thread, which protrudes from the point of entrance of the seed while it is in place, and by means of which it can be pulled out when the desired period of

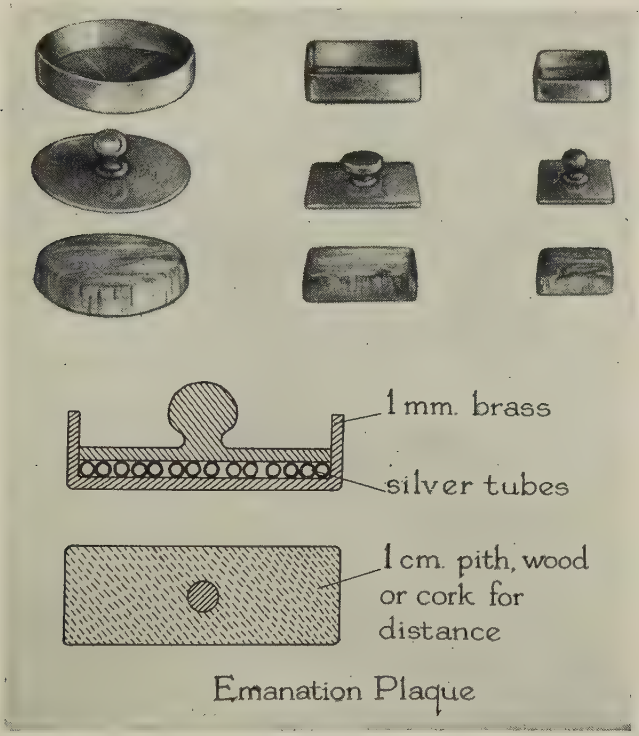

Fig. 109.—Emanation plaques of various shapes and sizes and a detail drawing of one in cross section.

radiation is concluded. This thread thus serves the double purpose of marking the site of the seed while it is in use, and making it readily removable whenever withdrawal is desired. If for any reason it is desirable to leave the implants permanently *in situ*, the thread can be omitted when the seed is made up. The implant will then be a smooth minute platinum cylinder.

Radium salts are placed directly in hollow *needles* with soldered screw caps. These needles are made of platinum, gold, or dense noncorrosive alloys. They usually contain 1, 2, 5, 10, 12½ mg. radium as sulphate, and are from 20 to 30 mm. in length, with a wall thickness of 0.35 to 0.5 mm. and a diameter at the widest point of 2 mm. Steel or monel metal needles allow a large percentage of beta radiation to pass through, and are therefore not in accordance with present ideas of filtration. The amount of radium or radon placed in each needle varies widely, but there is a tendency to prefer small quantities in order to avoid sloughing.

The needles are threaded, sterilized, and inserted into the mass of the lesion by means of a small pointed hemostat, left in place for sufficient time to give the desired dose, and are then removed. In dense tissues a trocar or scalpel is first used to facilitate the insertion of the needle without force. The method necessarily traumatizes the tissue. The needles are always threaded with silk so that they may be withdrawn at the end of the exposure. Local anesthesia is not usually necessary for the implantation of needles in dermatological conditions.

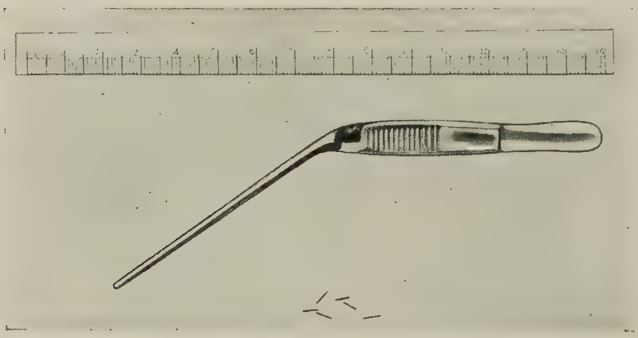

Fig. 110.—Seeds, and forceps used for handling them.

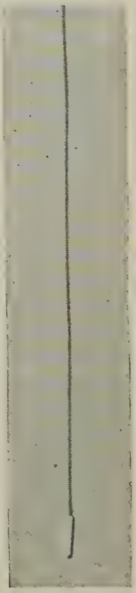

Fig. 111. — Platinum removable implant.

Hollow needles, similar to those used for radium, containing a radon tube about 13 mm. in length and 0.8 mm. in diameter fulfil the same uses as needles of radium salts.

To summarize: One uses in everyday dermatological practice: 1. Unfiltered radiation in the form of (*a*) flat salt applicators; (*b*) the bare tube plaque or bulb; (*c*) glass capillary emanation tubes upon the end of a wooden spatula, or (*d*) glass implants inserted into the substance of tumors.

2. Radiation filtered through 0.5 mm. silver, which removes nearly all the beta rays and some of the softer gamma rays, in the form of (*a*) flat salt applicators and (*b*) tubes.

3. Radiation filtered through 1 mm. of platinum, which removes all the

beta rays and a large percentage of the softer gamma rays in the form of needles.

4. Radiation filtered through the equivalent of 2 mm. of brass, in the form of (*a*) a silver tube encased in an additional covering; (*b*) screened flat glazed salt applicator; (*c*) gamma-ray tray consisting of silver tubes in a brass box.

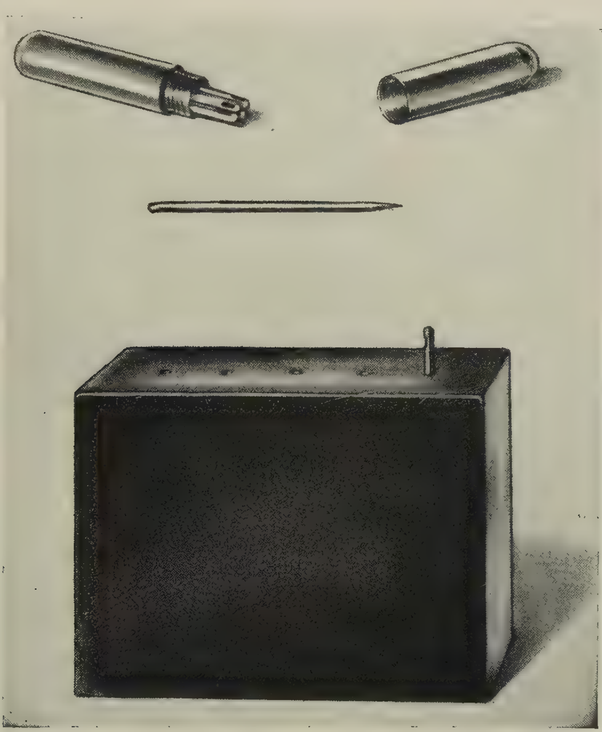

Fig. 112.—Radium needle, bundle tube containing five needles, and holder for needles so that they may be used as a flat applicator.

5. Radiation embedded in tissues in the form of platinum or gold implants, giving practically only gamma radiation.

These methods are not in any manner standard. They are simply the ones that have given the author the best results. Other workers use different filtrations and other forms of applicators in accordance with the technic developed by the special problems of other clinics, and by the results of their research departments.

Technical Details.—Molds of lesions made of *plastic substances*[1] are widely used for the treatment of skin tumors by silver tubes containing the salt or emanation. For plastic purposes nonmetal filled dental modeling compound has general favor in this country. It comes in solid cakes, which readily soften and become pliable when placed in hot water. While still hot, a piece

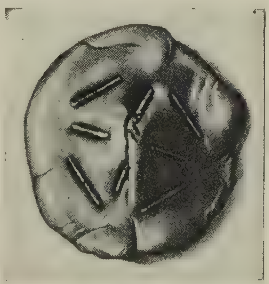

Fig. 113.—Mold made of ulcerated lesions and silver emanation tubes arranged in it.

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[1] Edling, Lars: On Plastic Means of Application in Radium Therapy, Acta radiol., **1**: 60–88; 219–242, 1921; Ab. Radium Therapist, 1: 155–156, May, 1922.

approximately the size of the lesion is firmly pressed directly upon the lesion and retained in this position until it hardens. After it is removed, grooves large enough to contain silver tubes are cut in the inner surface at points so distributed that all parts of the lesion will receive the dosage desired. The grooves are usually cut to a depth that permits a thin layer of dental compound to be placed over the tube so that the latter is sunk at a distance (generally 3 mm.) from the lesion, one tube being placed to every square centimeter.

Tests made at the Institut du Radium at Paris have led to the adoption of the following compound[1]:

Beeswax	100	Gm.
Paraffin wax (melting at 62 C.)	100	"
Fine sawdust	20	".

In the treatment of a small lesion when only one tube is used, it is permissible to push it carefully into and almost through the hot mold while the latter is still upon the lesion. This procedure is not as accurate as the former method, but saves considerable time and is satisfactory in experienced and careful hands.

A few niceties in the details of the above method deserve mention. It is advisable before the mold is made to draw lines with a skin pencil or ink at right angles through the center of the lesion, extending upon the normal skin outside the area which is to be covered by the mold. These lines serve as indications of the exact location of the lesion. They are absolutely necessary for accurate manipulation when the silver tube is inserted through the hot mold while it is still upon the patient. After the lines are drawn the lesion and skin about it should be coated with a thin layer of vaselin, which prevents the sticking of the mold to the tissues, the tearing of friable structures and bleeding when the mold is removed. The receptacle used for the heating of dental modeling compound should be an old enamel cup or basin because it will stick to it and prevent its use afterward for other purposes. When the operator handles the hot compound, he should keep his hands wet or otherwise it will stick to them and make the manipulation difficult.

For external application, distance is usually obtained by the use of wooden, paraffin, cork, or rubber blocks cut the size of the applicator and of desired thickness (generally 5 mm., 1 cm., 3 cm., 6 cm., or 10 cm.). When inserted into cavities silver or brass tubes are covered with sterile rubber tubing, which keeps the radium at a distance from the surface under treatment and absorbs soft secondary radiation produced by the metal container. In contact applications when a filter has been inserted the irritating secondary rays from it should also be screened off by the interposition of rubber, cork, or gauze between the radium container and the skin surface. If rubber is used it should not contain any metallic constituent that might itself emit secondary radiation.

Position.—Aside from placing radium or its products directly in *contact* with the lesion, one may use *distance application* in order to afford a more homogeneous depth distribution of the energy, or the radioactive substances may be implanted in the diseased tissues—which is known as interstitial therapy.

The factor of *distance* in the technic of radium application is often entirely overlooked though it is of no less importance than screening. The effects of distance have been explained so clearly by Dr. Viol[2] that his words and diagram are quoted:

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[1] Esguerra, A., Monod, O., and Richard, G.: Generalites sur l'emploi des substances plastiques en Curithérapie de surface, J. de radiol. et d'électrol., 6: 331–341, 1922.

[2] Viol, C. H.: Distance as a Factor in the Local Application of Radium, Radium, 11: 24–26, May, 1918.

"The roentgenologist has come to appreciate this distance factor as one of immense importance in his work, and the distance between the rayed tissue surface and the tube is carefully regulated. When radium is used, it might seem to one giving the matter only casual thought that the tiny differences in distance between the radium and the tissues, amounting usually to a few millimeters, would not be very significant. Considering the rays as coming from a point source, the falling off in intensity of the radiations with distance takes place in accordance with what is known as the law of inverse squares. This is best illustrated by the diagram given (Fig. 116).

"The radium is assumed to occupy a point at the top of the square pyramid. This pyramid outlines the path of a beam of rays from the radium, the dimensions of the pyramid being so chosen that the beam of rays passes through a square of 1 sq. mm. area, at a distance of 1 mm. from the radium. This being the case, it follows that all of the rays which at 1 mm. distance pass through 1 sq. mm. area, pass through an area of 4 sq. mm. at a distance of 2 mm. from the ray source. This is shown in the diagram, where corresponding to a distance of 2 mm., the area of the plane is given as 4 sq. mm., and the dose of rays per square millimeter is consequently equal to the total dose divided by the number of square millimeters over which it is spread, viz., one fourth equals 0.25. It is assumed that there is no absorption of the rays. The area of the square corresponding to a given distance from the ray source, is equal to the square of the distance, and the concentration of rays is the inverse of this area, hence the law of 'inverse squares' to express the variation of concentration with distance.

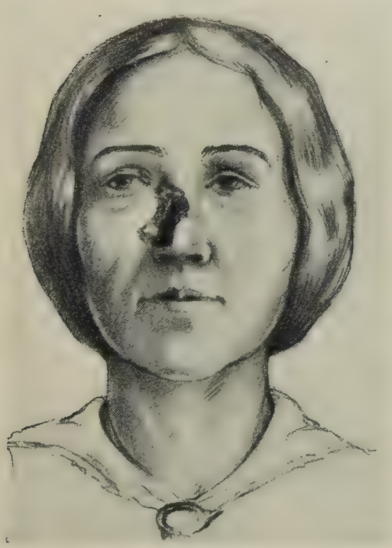

Fig. 114.

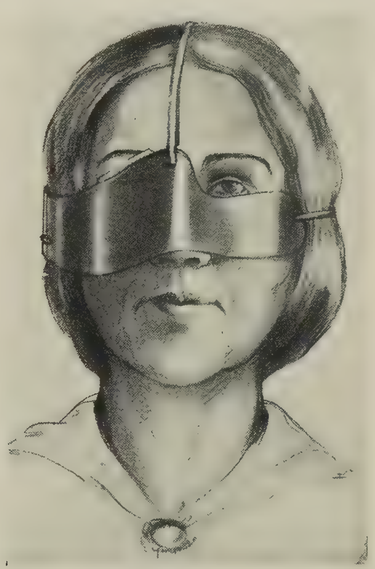

Fig. 115.—Mask for holding radium applicator in place.

"One point of importance which the diagram in Fig. 116 makes clear is the advantage which is gained by having a radium preparation at a little distance from the tissues that are being rayed, *i. e.*, so-called 'distance filtration.' It is seen that the falling off in ray dose per square millimeter is very rapid in the first few millimeters, the dose falling from 1.0 at 1 mm. to 0.04 at 5 mm. Consequently a layer of tissue 4 mm. thick, which had the radium 1 mm. distant, would receive at the surface nearest the radium twenty-five times the ray dose that (neglecting absorption) would be received by the tissue surface 5 mm. from the radium. Due to the absorption of rays (1 cm. soft tissue absorbs about 3 per cent of the hard gamma rays), the ray dose received by the outlying tissue would be even somewhat less. The same 4 mm. layers of tissue, if placed so that the radium is 6 mm. distant, will receive on the near surface a ray dose of 0.028 and on the far surface a ray dose of 0.010 per square millimeter. This is a ratio of three to one, as compared with the ratio of twenty-five to one in the other case. It is obvious that the second arrangement would require a longer application of the radium to attain a given total dosage; however, the different layers of tissue would be receiving more nearly the same dose of rays, and this is one of the most important points in the technic of radium therapy."

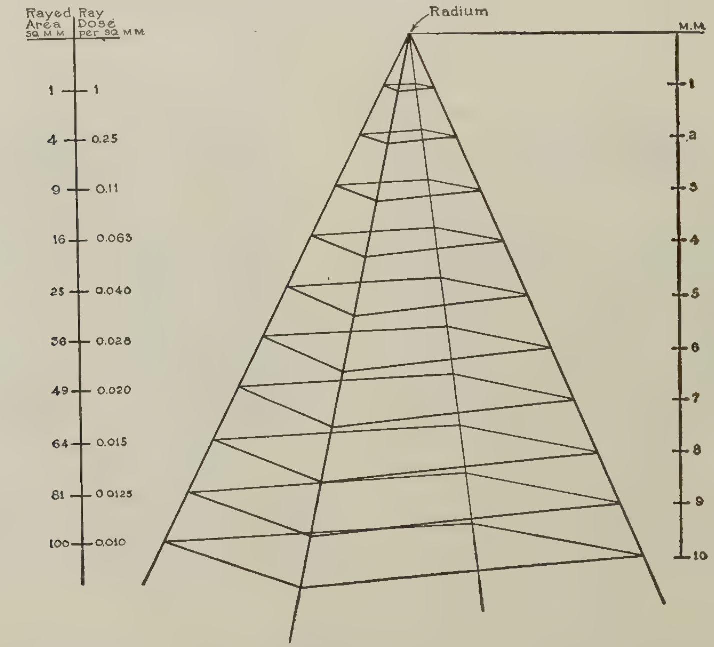

Fig. 116.—Illustration of the effects of distance in the local application of radium. (Courtesy of Dr. C. H. Viol.)

Almost invariably in the use of external radiation upon deep skin neoplasms, it is necessary to produce excessive destruction of the superficial parts in order to get sufficient depth dose to destroy the actively infiltrating zone of the tumor. The amount of radiation which can be effectively used at a depth is limited solely by the toleration of the overlying tissues. Regardless of the economic features pertaining to the loss of the major portion of avoidable radiation through its distant application, the therapeutic error of getting the least energy effect upon the most important part of the tumor is the commonest fallacy of external radiation and forms the foundation upon which the method of interstitial radiation has been developed.

Interstitial therapy is the insertion of radium or radon preparations into the diseased tissues. The salt is used in needles, and the emanation is used in similar containers or in smaller ones called implants.

Such therapeutic use of radon has made possible the burying of small tubes containing it in the tissues and leaving them *in situ*. The method possesses the advantages of simplicity, accurate distribution of the radiation, and prolonged exposure. At first, glass capillary tubes called "seeds" were employed, but the extremely painful, severe necrosis produced by the soft quality of such unfiltered radiation led to the adoption of metallic containers of gold or platinum. The emitted radiation from a glass implant is 96.5 per cent beta and 3.5 per cent gamma, while the emission from a gold implant (0.2-mm. wall) is only 3.72 per cent of that from one of glass containing the same amount of radon. In the latter instance the distribution, however, has changed because of the filtration to 22.5 per cent beta and 77.5 per cent gamma. Increasing the wall thickness to 0.3 mm. further changes the relation of emitted radiation to 8.8 per cent beta and 91.2 per cent gamma, with a reduction of about 15 per cent. The metal implant, an outgrowth of the other two types, is preferred for interstitial radiation.

Interstitial radiation is then of three major varieties: (1) Gold or platinum implants; (2) bare seeds, and (3) radium needles.

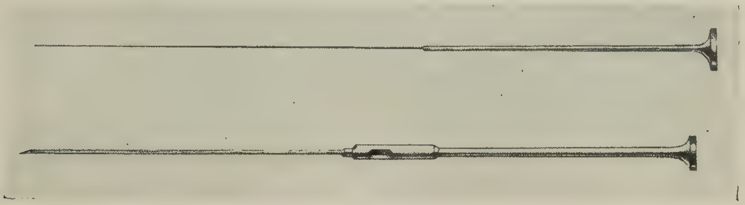

Fig. 117.—Instrument for implanting seeds, and stylet.

Gold and platinum implants are the most modern forms. Because of the possibility of carrying infection deeper into the healthy tissue, they should not be inserted through an ulcerating infected growth which is not draining freely. Otherwise the inflammatory reaction may be enhanced and marked sloughing may take place. Whereas bare glass seeds cannot be placed in the vicinity of bone, cartilage, nerve trunks, or large blood vessels, these implants may be used in such localities without hazard. But it is in the matter of exactness in dosage that the advantage of the filtered implant is most in evidence.

Frequently the emanation is best implanted in the healthy tissue at or near the infiltrating edge of the growth, for the radiation should be equally and thoroughly distributed in the actively growing periphery of the neoplasm, as well as in the central portion. The dosage depends somewhat upon the shape of the tumor, the cross-fire being greater for spherical masses. Increasing the number of tubes and decreasing their content result in a more equalized distribution, with avoidance of severe reaction. Prior to the implantation of radium, it is desirable to use external radiation for a purpose similar to that of preoperative radiation and to reenforce the dosage of the implants effectively.

Removable platinum implants are sterilized by boiling, and, with strict asepsis, are placed in the trocars, there being one trocar for each implant. The thread should be cut so that it is only 3 cm. long, because that length is sufficient in dermatological work and long threads are objectionable as they tend to pull the implant out of place by sticking to the trocar when it is withdrawn. The skin at the site of injection is shaved if necessary and painted with tincture of iodine. A small injection of novocaine and adrenalin solution produces a local wheal which affords adequate anesthesia for the puncture. While the operator is palpating and exerting counterpressure with the other hand, the trocar is introduced to the desired depth. The ends of these platinum containers are rounded, and one depends upon the insertion of the trocar needle to separate the tissue, then withdraws a short distance before pressing the plunger. The stylet is then completely removed and the trocar withdrawn slowly and carefully, so as not to pull the thread connected to the implant. After the trocar is out, the external end of the thread is visible and is made adherent to the skin by collodion. After this has dried a sterile dry dressing is applied. Gold implants are sterilized in alcohol and embedded by the use of small trocars, surgical cleanliness always being observed. After implants are inserted, a radiograph may be taken to prove that they are correctly placed, both in regard to the lesion and in regard to one another.

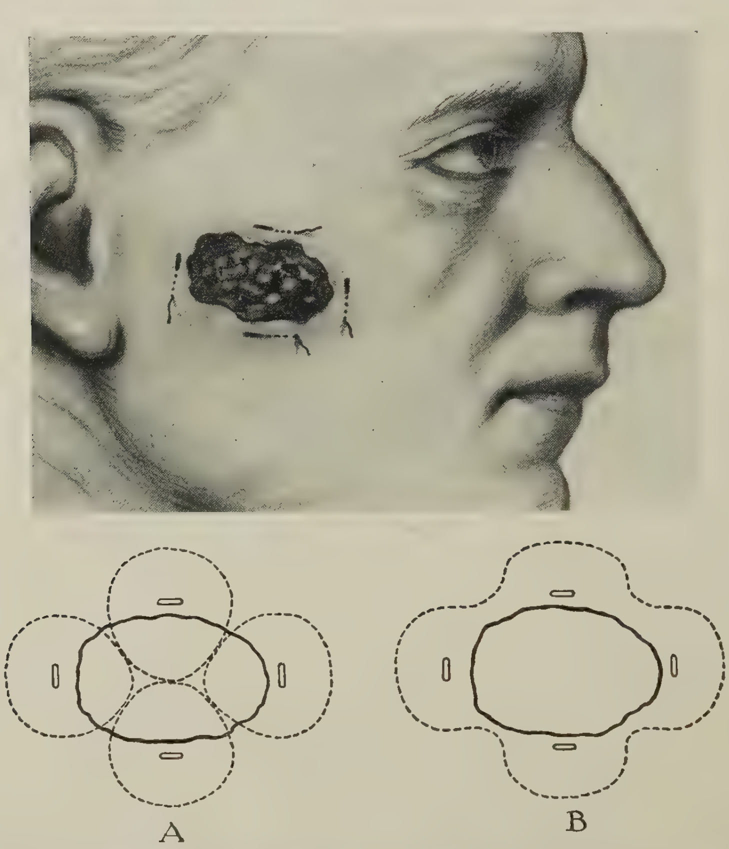

Fig. 118.—Illustration of the treatment of a basal-cell epithelioma of the cheek by removable platinum radon implants. Below, a schematic drawing showing: A, Zones in which each seed gives a primary full dose. B, Zone receiving a full dose due to overlapping. (Courtesy of Dr. Joseph Muir.)

Dosage.—Various terms used in radiotherapy are defined as follows:

The *dose* is the product of the intensity times the duration of the exposure. One milligram for one thousand hours is the same dose as a thousand milligrams for one hour. But the biological effect upon actively growing cells is not the same; therefore descriptive details of each application are desirable.

There are three recognized methods of calculating dose: (1) By milligram hours; (2) by millicurie hours, and (3) by microcuries destroyed per hour.

Milligram hours represent the amount of radium element used, multiplied by the duration of the application in hours, *i. e.*, a milligram hour is the amount of radiation given off by 1 mg. of radium element during one hour. When radon is employed, the term "millicurie" is substituted for milligram, and allowance should be made for decay during prolonged application (see table in Appendix). In the use of unfiltered radiation, the terms "milligram minutes" or "millicurie minutes" are often convenient.

As has been stated, a microcurie is the thousandth part of a millicurie. It may be used to indicate the intensity of a radium preparation in equilibrium by the quantity of emanation destroyed per hour. One milligram of element in equilibrium destroys 7.51 microcuries of radon per hour. The conversion of milligram hours into microcuries destroyed is obtained by multiplying the number of milligram hours by 7.51. For instance: 200 milligram hours = 200 × 7.51 = 1502 microcuries destroyed.

To convert microcuries destroyed into milligram hours, the number of microcuries destroyed must be divided by 7.51. For instance:

50 microcuries destroyed = $\frac{50}{7.51}$ = 6.66 milligram hours.

In the use of microcuries as units of intensity, multiples of five facilitate calculations, and for convenience the content of the radium applicator is regulated by the following computation:

For 5 microcuries destroyed per hour 0.66 mg. of radium element.
For 10 microcuries destroyed per hour 1.33 mg. of radium element.
For 25 microcuries destroyed per hour 3.33 mg. of radium element, *et cetera.*

Adequate dosage is necessary for satisfactory results, and to quote from Quick: "A good working rule to carry in mind (in the treatment of cancer) is to assume that it is the last 10 per cent, and not the first 90 per cent, of the dose which makes possible the accomplishment of the desired result." In the treatment of skin cancer, the first dose is the most advantageous and effective one, and an effort should always be made to obtain complete regression by this single dose.

It should be the constant endeavor of the radium therapist to obtain as nearly as possible a *homogeneous dosage* in all parts of the lesion. To effect this homogeneous irradiation, the various devices such as cross-firing, the use of radium spread over a considerable area as in the flat plaques, the use of a number of tubes placed about the lesion (or a number of needles or implants placed into it), or trays at varying distances, have been adopted. Screening, which regulates the quality of radiation, is most important. All these methods have their advantages and limitations. Dosage is thus influenced by the morphological details of the application, the chief of which are the distance from the skin, the filtration, the size of the applicator, the distribution of the radiating material, and whether the source of radiation is a point, a tube, or a unit of another form.

Whenever exposures are repeated the *intervals between the treatments* in fluence the dosage. In general, it is necessary to delay such subsequent treatment about one month when the first exposure results in an erythema, if increased skin reaction after the second exposure is to be avoided. The interval between treatments depends upon the dosage and the quality of the radiation, but most of all upon the disease under treatment. This subject will be taken up specifically in other chapters.

The *distance* between the radium and the skin surface, as previously stated, has a tremendous effect upon the dosage. For a point source of unfiltered radiation, intensity varies inversely as the square of the distance from the source. Obviously, the law is only roughly applicable to the tubes, plaques, and other forms of applicators in practical use, especially when filtered. Such applicators frequently have areas of several square centimeters or are covered by metal screens, in which cases the inverse square law is but slightly approximate. Quimby has worked out tables for applicators of different sizes for various distances, so that doses from them may be compared directly, and by means of curves or tables a comparison may be made for any practical applicator at any distance. Also, if the dose is known for one applicator under a given set of conditions of distance and filtration, it may

TABLE 15

Erythema Doses in Millicurie Hours for Tubes and Plaques Having Filtration of 0.5 Mm. Silver

Tubes, 14 mm. long.

Distance, mm.	Dose, mc. hr.		
On skin	3		
3	10		
5	20		
10	60		

Square plaques.

Distance, mm.		Dose, mc. hr.	
	1 sq. cm., 1 cm. side.	2 sq. cm., 1.4 cm. side.	4 sq. cm., 2 cm. side.
On skin	7.5	13	16
5	20	27	40
10	55	65	80
20	190	200	220

Round plaques.

Distance, mm.	Dose, mc. hr.				
	0.5 sq. cm. 0.8 cm. diam.	1 sq. cm. 1. cm. diam.	2 sq. cm. 1.6 cm. diam.	3 sq. cm. 2 cm. diam.	4 sq. cm. 2.3 cm. diam.
On skin	6	11	15	18	21
5	15	23	30	40	45
10	50	60	65	75	85
20	180	190	210	215	220

These check with experimental doses for tube in contact with the skin and at 3 mm., and for 2 sq. cm. round and 4 sq. cm. square plaques. The doses for element plaques cannot be accurate because they vary among themselves. The 20-mm. doses are probably low in all cases.

be obtained for any other applicator under any ordinary conditions of application.

The following table of erythema doses for applicators filtered through 2 mm. of brass has also been taken from Mrs. Quimby's article,[1] and in addition, the author has had her kind assistance in the preparation of a table of skin doses for tubes and plaques with a filtration of 0.5 mm. silver, based upon clinically determined erythema doses supplied to her, namely, silver tube on the skin (1 mm.), 3 millicurie hours; at 3 mm., 10 millicurie hours.

TABLE 16

ERYTHEMA DOSES IN MILLICURIE HOURS

Applicators having filtration equivalent to 2 mm. brass and 2.4 mm. rubber

Distance, cm.	*Tubes*—Length.			*Circles*—Diameter.					
	1 cm.	2 cm.	4 cm.	1 cm.	2 cm.	4 cm.	6 cm.	8 cm.	10 cm.
1.0	173	206	294	180	234	406	640	940	1,285
1.5	374	409	526	381	437	640	918	1,250	1,675
2.0	654	692	824	661	728	936	1,250	1,620	1,850
3.0	1455	1500	1,640	1470	1,530	1,760	2,120	2,720	3,060
4.0	2570	2620	2,770	2570	2,670	2,880	3,270	3,790	4,370
5.0	....	4000	4,240	4000	4,120	4,370	4,650	5,150	5,760
6.0	....	....	6,000	....	5,760	6,000	6,550	6,860	7,580
7.5	....	....	9,000	....	9,000	9,000	9,600	10,300	11,000
10.0	....	....	16,000	....	16,000	16,000	16,000	18,000	18,000

Squares—Length of sides.

	1 cm.	2 cm.	4 cm.	6 cm.	8 cm.	10 cm.			
1.0	190	252	439	686	1,000	1,385			
1.5	386	465	686	986	1,600	1,780			
2.0	670	762	1,000	1,350	1,760	2,250			
3.0	1485	1,530	1,870	2,250	2,720	3,350			
4.0	2620	2,670	3,070	3,600	4,000	4,650			
5.0	4000	4,240	4,500	4,970	5,540	6,260			
6.0	....	6,000	6,260	6,860	7,580	8,000			
7.5	....	9,000	9,600	10,300	11,000	12,000			
10.0	....	16,000	16,000	18,000	18,000	18,000			

Rectangles—Length of sides.

	1 × 1.5 cm.	2 × 3 cm.	4 × 6 cm.	6 × 9 cm.	8 × 12 cm.	10 × 15 cm.			
1.0	198	290	565	974	1,470	2,060			
1.5	400	502	838	1,275	1,845	2,675			
2.0	679	792	1,285	1,655	2,250	3,000			
3.0	1485	1,600	2,000	2,620	3,350	4,120			
4.0	2620	2,720	3,200	3,790	4,650	5,540			
5.0	4000	4,240	4,650	5,340	6,260	7,200			
6.0	....	6,000	6,260	7,200	8,000	9,000			
7.5	....	9,000	9,600	10,300	11,100	12,000			
10.0	....	16,000	16,000	18,000	18,000	18,000			

There is no simple standard of dosage generally applicable. In therapy it is customary to use only the soft (beta, unfiltered) radiation or hard (gamma, "screened through brass") radiation, mixtures of the two (thinly screened applicators) not being so frequently employed. With the beta rays the therapeutic dose has no relation to the erythema dose and may be a hundred times greater. The erythema dose of beta rays is therefore of very little significance, the therapeutic dose of these rays being so different from it. On the other hand, the therapeutic dose of gamma rays like that of hard *x*-rays is rarely more than two or three times the erythema dose, because greater amounts would produce irreparable damage. The therapeutic dose of gamma rays thus bears a sort of relation to their erythema dose. Common empirical doses for the various types of skin lesions will be but briefly covered in this chapter, receiving more consideration under the captions of the respective diseases.

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[1] Quimby, Edith H.: The Effect of the Size of Radium Applicators on Skin Doses, Am. J. Roentgenol., 9: 671–683, Oct., 1922.

Flat Applicators.—The dosage of flat glazed applicators varies within very wide limits. Loosely speaking, reactions of the first degree follow exposures of ten to twenty minutes with "half-strength" applicators, or five to fifteen minutes with "full-strength" applicators, unscreened. Second degree reactions are produced by unfiltered exposures of twenty-five to forty minutes with "half-strength," or fifteen to thirty minutes with "full-strength" plaques. Third degree reactions result from unscreened applications of forty-five to sixty minutes with "half-strength," or thirty to forty-five minutes with "full-strength" sources. The exposure times for fourth degree reactions range from one and one half to four hours with "half-strength" applicators, or one to three hours with "full-strength"' applicators, unscreened.

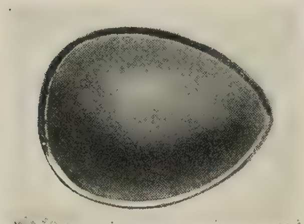

Fig. 119.—Brass eye shield. This is coated with paraffin and is inserted between the lids and the eyeball, the parts being anesthetized by holocaine solution.

Flat glazed applicators 2 cm. square and containing 10 mg. of radium are in common use. Unscreened, this standard 10 mg. half-strength radium plaque in direct contact with the skin will produce an erythema in about ten minutes, an erythema and temporary epilation in about twenty minutes, and an intense erythema with desquamation and exudation in thirty minutes, vesiculation and superficial ulceration in about fifty minutes, and a destructive reaction in about ninety minutes. For children the dosage should be reduced approximately 30 per cent. The action is largely a beta ray effect extending to the depth of a few millimeters, which is often suitable for skin therapy. The erythema begins a few days after treatment, and persists in mild reactions for two weeks, and in severe reactions for six to ten weeks with associated exudation and ulceration.

In the treatment of epitheliomas, distance application and filtration of 2 mm. brass or its equivalent are necessary. For such purposes the radon applicators described on page 199 should be employed instead of the flat glazed applicators, the use of which should be restricted to benign and precancerous lesions. In the treatment of the latter, the erythema time should be multiplied many times to obtain an adequate dose for the lesion. As stated, a great latitude exists between a perceptible erythema and a real destruction of tissue. The half-strength, unscreened flat glazed applicator exerts an effective reaction at a depth of about 0.5 cm. when applied for two or four hours in contact with a superficial lesion. With the same applicator and a screen of 0.1 mm. lead or silver, the depth of the effective reaction is about 1 cm., with an exposure time of four to six hours. The depth may be further in-

TABLE 17

Table of Therapeutic Exposure Times for Half-strength, 10 Mg. Flat Glazed Salt Applicator (2 Cm.^{2})

	Contact.		Distance, 1 cm.	
	Slight reaction.	Intense reaction.	Slight reaction.	Intense reaction.
Unscreened	10–30 min.	2–4 hr.	9 hr.	Quantity insufficient for practical use on lesions which require intensive dosage from a distance.
0.2 mm. lead or silver	1 hr.	6–10 hr.	9 hr.	
0.5 mm. brass	1 hr. 30 min.	10–14 hr.	9 hr.	
0.5 mm. lead or silver or 0.75 mm. brass	2 hr.	15–20 hr.	10 hr.	
2 mm. brass	7 hr.	20–30 hr.	28 hr.	

creased by the use of a filtration of 0.5 mm. brass, which, with a full-strength plaque, requires an exposure of ten to fourteen hours for proper treatment of small, fairly deep lesions. Some workers prefer to divide the total dosage into a series of applications of two to four hours at intervals of twelve to twenty-four hours in order that as many cells as possible may receive radiation during their periods of mitosis. From these figures the dosage for other sizes and shapes of flat glazed applicators of quarter, half, full, or double strengths can be estimated. The influences of filtration upon the exposure time necessary to give a certain reaction can be generally gauged from the table on page 180. By visualizing, as far as possible, the pathologic condition to be overcome, a filter may be selected which will afford the necessary protection against the softer rays, although, as stated, the tendency is to use the applicators either unfiltered (for beta-ray effect) or filtered through at least 2-mm. brass (for gamma-ray effect).

Bare Emanation Tubes, Plaques, and Bulbs.—In a very general way, one may say that a contact treatment of 30 to 60 millicurie minutes per square centimeter will produce a mild erythema in adults. In children even smaller doses cause visible reactions. These doses are of therapeutic value only in the treatment of port wine marks.

Doses of 150 to 300 millicurie minutes produce an intense local erythema, edema, and desquamation. This dose is employed upon the discoid type of lupus erythematosus, upon small keratoses and warts, and stationary types of leukoplakia.

Doses of 400 to 600 millicurie minutes produce superficial ulcerations, which heal in from six to eight weeks. These doses are employed on tiny basal-cell epitheliomas, thick keratoses, ulcerated or active types of leukoplakia, large common warts, and lupus vulgaris. Larger lesions are covered by multiple applications, the same dose being used for each area. The radiation from the bulb may be filtered through 2 mm. of brass for gamma-ray action on tiny deep-seated lesions. The need for this method is rare, but when used the dose varies from 20 to 80 millicurie hours.

The reaction from these unfiltered applicators appears a day or two after exposure and disappears in from two to eight weeks, according to the dosage. The effects are limited to about 2 mm. depth. The treatment is therefore useful only on very superficial lesions. Such soft radiation exerts chiefly a caustic action. In therapeutic doses healing is always prompt, but atrophy telangiectasia, and depigmentation are likely to supervene unless the areas treated and the doses used are very small.

Tubes.—An erythema is produced by a *silver tube* (page 184) in contact with the skin by a dose of about 4 milligram hours. This dose is useful only occasionally in the treatment of linear keloids or small angiomas. The greatest service of silver tubes is in the treatment of small basal-cell epitheliomas. For this purpose one or more tubes may be used. When the lesion is less than 1 cm. in size, one tube is sufficient, but for larger lesions more tubes are desirable. The tubes are applied at a distance of 3 mm. in dental compound applicators, in doses from 50 to 75 milligram hours per square centimeter. In small lesions where one tube is used the dose is 70 to 80 millicurie hours per square centimeter; whereas in larger lesions the dose is reduced below 60 millicurie hours per square centimeter on account of cross firing. With this technic, a unit dosage of 60 milligram hours per square centimeter of surface is an average in basal-cell epitheliomas. Besides the size of the lesion, its shape, proximity to bone, cartilage, or the eye and its pathologic character influence the dosage.

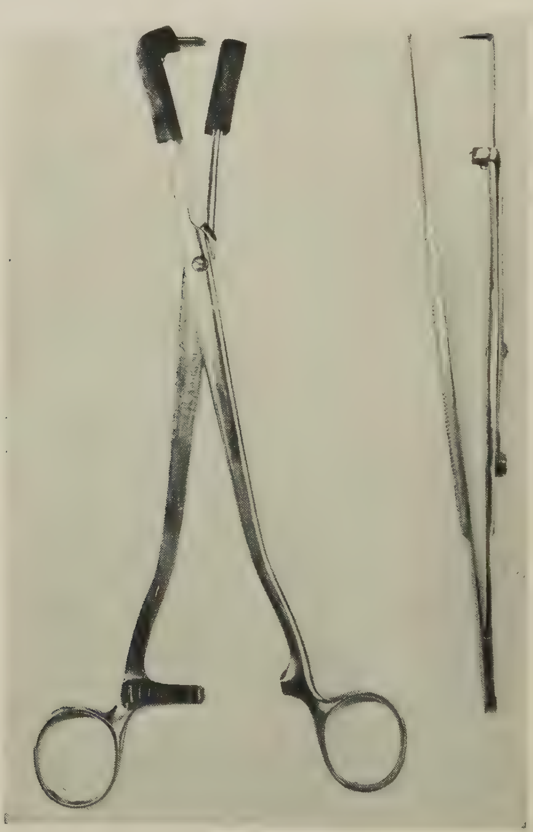

Fig. 120.—Instruments for handling and unscrewing tubes. (Courtesy of Dr. William H. Cameron.)

Silver, brass, and platinum tubes are especially suitable for treatment of lesions in the aural canals, nostrils, and other body orifices. The dosage for tubes thus used varies with the filtration and the nature of the disease. In general, the dose for silver tubes is between 60 to 75 milligram hours, the tubes being surrounded by sterile rubber tubing to absorb secondary radiation and to maintain a distance of 2 or 3 mm. between the tube and the surface under treatment.

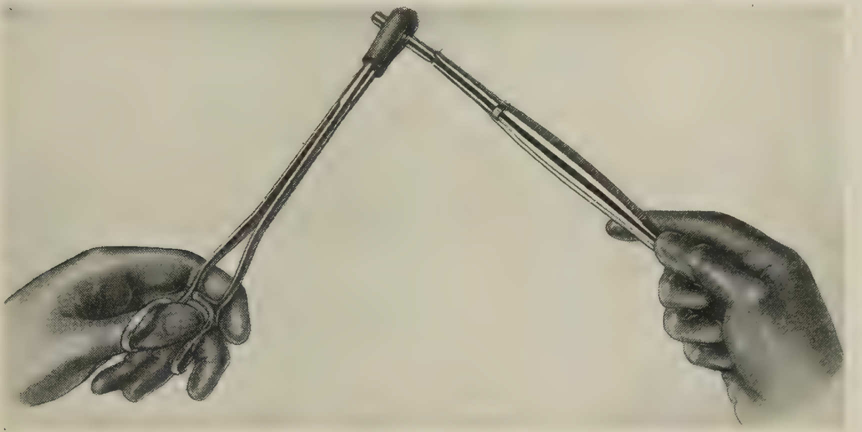

Fig. 121.—Unscrewing a metal tube with the foregoing instruments.

Silver tubes placed in brass boxes or trays form gamma-ray applicators of various sizes and shapes. The tubes should be spaced, and the distance of the application should be measured from the skin to the center of the radioactive source. Usually the applicators so constructed have a total filtration equivalent to 2 mm. brass. These applicators are called trays or packs and are used at a distance for penetrating effects. The advantages of using these brass applicators at a distance for the treatment of skin neoplasms cannot be overemphasized (see page 929). They entail a greater depth dose, a wider radiated area, and a larger percentage of good results with less scarring than any other surface applications. It requires much more radium to give treatments from

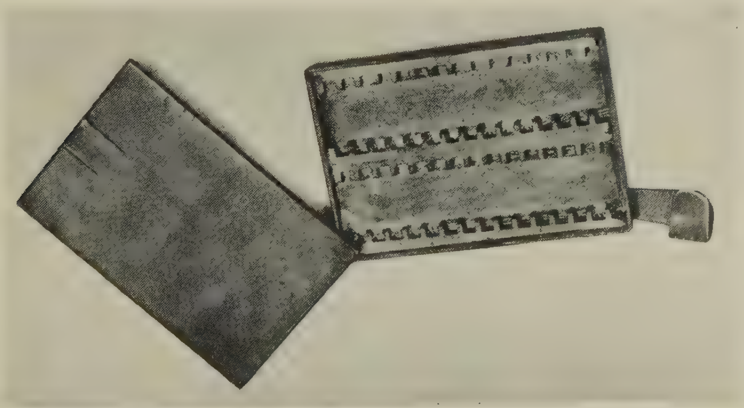

Fig. 122.—Tray made of brass showing grooves for silver tubes.

a distance and filtered through 2 mm. of brass, but the results amply justify such disadvantages. In fact, this is the type of treatment for small skin tumors and with adequate dosage is highly successful. For larger lesions the distance and the dosage should be proportionately increased.

This type of applicator is the most common means of treating squamous-cell epithelioma of the skin, and is very frequently used upon basal-cell lesions. It is applicable to skin sarcomas, the tumors of mycosis fungoides, and leukemia. The erythema doses of such applicators are given in Table 16, and the applicators are illustrated in Figs. 109 and 122. The doses in the table have been approved by the Standardization Committee of the American Radium Society.[1] These doses are not necessarily therapeutical doses, which may be considerably larger or smaller, their magnitude depending upon the requirements of the case. For the treatment of epithelioma the doses given in Table 16 may be doubled or increased even further when there are special indications. This is particularly true for bulky lesions. The surface of the applicator should always be larger than that of the tumor, so that the edges of the latter will be adequately irradiated.

In general, as the hardness of radiation increases, the number of erythema doses given for a therapeutical effect diminishes. With beta rays and superficial *x*-rays many times the erythema dose are used for one treatment. In fact, the difference between an erythema dose and a therapeutical dose with beta rays is so great that, as stated, the two have no relationship of any practical value. With *x*-rays of the quality ordinarily employed for dermatological work the therapeutical dose for epithelioma ranges from 2½ to 6 E. D. With high voltage *x*-rays this difference is diminished, and one finds that the therapeutical dose for an epithelioma is rarely higher than 2½ E. D. When gamma-ray applicators are employed, the margin between the erythema and therapeutical dose is still further diminished. For this reason the therapeutical dose for epitheliomas with these applicators, although greater than the erythema dose, should not be increased much beyond the latter, because defects of the skin that are irreparable may be produced.

The skin reactions from gamma-ray applicators appear in one or two weeks after the exposure. The doses given in Table 16 cause a faint erythema and a slight desquamation. The therapeutical doses for epithelioma produce more severe reactions, which begin with the appearance of an erythema a week after the treatment. This becomes progressively more intense during the following three weeks and is at its maximum four weeks after the date of the treatment. At this time the skin is red and swollen, and there is superficial ulceration which is covered by crusts or serous exudate. During the next four weeks the reaction disappears and the healing process is completed.

Another type of gamma-ray applicator which is used in large institutions is a brass box called a bomb, which contains one or more grams of radium. This radium is usually in silver capsules, the content of each being 50 mg. The bomb is suspended over the patient by a rack and pinion device, which allows accurate placement and focusing. This form of gamma-ray treatment is not used upon skin growths except when they have secondarily penetrated into the deeper parts.

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[1] From the Report of the Standardization Committee of the American Radium Society, Am. J. Roentgenol., 20: 258–261, Sept., 1928.

In the fractional treatment of tuberculous glands and metastases of tumors into glands, this type of radium application is used. It is also occasionally suitable for the treatment of large cavernous angiomas or circumscribed lymphangiomas. The dosage for these lesions should be modified.

Extensive surfaces such as those treated by these trays and packs may be irradiated less evenly by tubes screened with the equivalent of 2 mm. of brass at a distance of 1 inch, each tube covering 1 square inch of surface area in doses of 100 to 500 millicurie hours. Needles may be used in these applicators instead of tubes.

Unfiltered glass capillary tubes attached to the end of a small wooden spatula are used as substitutes for the bare tube plaque or the bulb, with a similar dosage (see page 197).

The regulation of dosage in *interstitial therapy* is largely empirical. About each implant there is a zone of tissue which receives a 100 per cent dose. In order to irradiate the lesion adequately, the implants should be distributed in it in such a manner that these 100 per cent zones are in contact, thereby giving all parts of the tumor an equal dose. Isodosage charts may be constructed, according to which the spherical tumor mass may be homogeneously irradiated.

Bare seeds (*glass implants*) are permanently embedded in tissue in amounts ranging from ⅛ to 2 mc. for each cubic centimeter of tumor mass, the average being ½ mc. This amount is stated in millicurie hours by multiplying the number of millicuries by 133. When the number of implants is multipled beyond a certain number (say five or six), it is customary to reduce the dosage given each cubic centimeter because of augmentation due to cross firing. The volume of the tumor is the most important factor in determining the dose, but, as has been said, the shape of the tumor must also be taken into consideration. There is reason to favor the smaller dosage thoroughly distributed. Equal distribution of small amounts of radiation increases the thoroughness of the radium treatment without causing points of severe necrosis. These prolonged applications of radiation produce a fractional sterilization of the malignant cells at their mitotic periods, when they are most susceptible to irradiation. The unfiltered implants may be used for the purpose of obtaining an intense beta radiation with comparatively little gamma-ray effect, since the latter represents a small fraction of the output.

The reaction following the interstitial use of bare seeds is very objectionable. Within a few days after implantation, severely painful swelling is caused by the soft radiation. The tissues become brawny and hot, and about each implant there is an area of liquefaction and necrosis, which commonly culminates in sloughing and ulceration. The destruction caused by such therapy devitalizes the adjacent structures so that healing is indefinitely prolonged. In this zone recurrences seem to appear and grow more rapidly than the original growth would have progressed in untreated tissues. These facts have led to the development of gold and platinum implants.

Gold implants are used in amounts of 1 to 4 millicuries per cubic centimeter in diseased tissue, the average being 2 millicuries. The gold capsule, by removing the soft beta radiation, decreases the sloughing and pain, and gives a more selective than caustic effect. In particular, the doses of gold implants for carcinoma are 2 to 3 millicuries per cubic centimeter, for angioma 0.8 to 1 millicurie per cubic centimeter; for keloid 1 to 1.2 millicuries per cubic centimeter.

Removable platinum implants possess some advantages over the gold implants, because they avoid the foreign body features of the latter and have a greater filtration. The dosage of the removable platinum implants is controlled largely by the time factor, it being customary to use 3 mc. implants routinely at equidistances of 2 cm. from each other. In carcinoma, with such technic the implants are withdrawn in ten days; in angioma, one to two days; in hypertrichosis, one day; in keloid, two to three days. For the ten-day period of radiation the dosage delivered by each implant is 333⅓ millicurie hours. The number of implants will be governed largely by the needs of the individual case, according to the dimensions of the surface extension and the depths to which infiltration has penetrated. In large lesions where several implants are used, due consideration must be given to the effects of cross firing. Implanters of different lengths permit the disposal of the implants at predetermined depths. Buried emanation, as has been said, should usually be preceded by a surface application of gamma radiation.

The method of implanting an epithelioma situated on the skin of the cheek is shown in Fig. 118. The lesion itself is indicated by a shaded circle; the points of insertion of the implanter are indicated also. Counterpressure is exerted from within the mouth while the implants are being placed from the outside.

Needles.—Ten-milligram needles are so placed in the tissue that each one is surrounded by at least 10 mm. and not more than 25 mm. of diseased tissue. The dosage of 10-mg. needles 1 cm. apart varies from 30 to 80 milligram hours, depending upon the nature of the pathologic process. When the quantities of radium contained are larger, the dosage is larger, being from 80 to 100 milligram hours, and the needles are separated by greater distances; for instance, 25-mg. needles should be separated by 2 to 3 cm. of tissue. The filtration of most needles is less than that of the gold and platinum implants so that the radiation from them is comparatively soft, although its quality depends entirely upon their construction. By judicious distribution a dose can be given to radiosensitive cells which will have a selective action resulting in their death without causing gross sloughing.

Radium needles are the method of choice for large cavernous angiomas within the buccal cavity and for deep-seated epitheliomas of the canthi, with due regard to local cleanliness. Although other types of dermatological lesions can be treated by them, better results can usually be obtained by other means.

The needles may be grouped in bundles and placed in brass tubular containers. These bundle tubes may be used like other tubes for gamma-ray effects.

Protection.—Because of their importance it is well to reiterate the professional risks associated with radium therapy. The foremost of these is careless handling of unfiltered radium, lack of precaution in this regard being a pernicious habit which leads to injuries to the fingers. The protection afforded by lead-rubber gloves is most efficient if the linings are kept absolutely clean. It is essential to maintain a distance of 2 to 3 feet from all unscreened radiation, working with long-handled forceps, with a screen opaque to the radiation placed between the body and the source.

In the use of large quantities of radium, gamma-ray injuries to the deeper organs, especially the hematopoietic system, are avoided by cognizance of the dangers and by alternating the operators. Absorption of radon by inhalation is of slight consequence, but rooms in which the work is done should be provided with exhaust fans.

All manipulations should be limited to a minimum and be performed with expedition. The operator should not remain in the radium environment longer than is required.

General Considerations.—Radium has been ascribed a very limited field in dermatology, and while it is true that *x*-rays are far the more useful of the two agents, it must be remembered that most dermatologists own only small amounts of radium, and their comprehension of its benefits has been limited by the amount at their disposal more than by its physical and clinical characteristics. There is an unfortunate tendency for an operator possessing a small quantity of radium to attempt the treatment of almost any lesion with it. The amount used should depend upon the indications for the individual case and not upon the amount of the radium in his possession. Flexibility is desirable. Several small containers may be used to greater advantage than a large one if the operator skilfully combines them. It is the aim to employ sufficient radium to heal the lesion in one treatment. In the present state of our knowledge such an ideal procedure is often impossible because of lack of uniformity in dosage.

Tissue reactions to radium are discussed at length in Chapter XI, and the reactions of the skin to each of the different forms of applicators have been discussed throughout this chapter. Generally speaking, the skin reaction may vary from a mild erythema to an intense necrosis. The various gradations of its severity merge into one another, but it is possible to define four degrees:

1. Simple erythema.
2. Erythema plus vesiculation.
3. The above plus superficial ulceration, and
4. Deep ulceration, healing slowly beneath thick crusts.

After unscreened or lightly screened radium treatments, the reaction is extremely superficial and, according to the dosage, may produce a pale erythema, an intense erythema with local swelling and epilation, exudation, vesiculation, and superficial necrosis. When severe the reaction may be pruritic, crusted, and painful. With increased screening, the surface reaction is proportionately diminished, because the softer radiation, the absorption of which would otherwise be concentrated in the epidermis and upper layers of the corium, has been removed. The penetrating radiation which results from heavy screening causes deep effects in the following sequence: Epilation, erythema, vesiculation, and necrosis. Severe reactions from gamma rays are likely to cause indolent ulcerations which may become carcinomatous. Adequate treatment of diseased tissue usually requires reactions of a certain order, but the line of distinction between a therapeutic reaction and one which is insufficient or excessive is the most difficult problem with which we have to deal.

The interval between treatment and the onset of the reaction varies from a few hours to several weeks, the duration of the interval being inverse to the magnitude of the dose, and to the concentration of the energy upon the skin. Occasionally the interval between the exposure and the appearance of the reaction is unusually short or long, and this is apparently due to individual idiosyncrasy.

The tissue reaction to interstitial radiation from gold or platinum implants is usually apparent in about five days. The skin overlying the lesion becomes a dusky red color, the hairs loosen, and with large doses there are swelling, intense pain, and exudation. The reaction disappears in four to five weeks, having reached its maximum in about three weeks. Ulcerated lesions regress without sloughing, their surface becoming epithelialized.

Indications.—The utility of radium is definitely established in an important group of skin diseases, which includes the many types of cancer of the skin, precancerous lesions, vascular nevi, keloids, keratoses, verrucae, keratodermas, leukoplakia, lupus erythematosus, lupus vulgaris, kraurosis vulvae, and vernal catarrh.

There are many other dermatoses in which radium therapy is beneficial but in which *x*-ray therapy is more practical, radium being used only in the exceptional case. Among the innumerable diseases included in this group are: Localized pruritus, eczema, neurodermatitis, lichen planus, psoriasis, hypertrichosis, dermatophytosis, tuberculous adenitis, morphea, clavus, synovial lesions of the skin, tinea capitis, and Dupuytren's contracture.

The choice between radium and *x*-rays in dealing with benign lesions rests upon their extent, volume, and depth. In the handling of circumscribed lesions, especially those of vascular or highly cellular character, the selective properties of the gamma rays of radium are of outstanding importance.

Aside from the palliative value in advanced cases of malignant disease, the scope of radium therapy has gradually broadened so that it is now given preference in the treatment of the primary growth of some types of cancer while in the operative stage. In the treatment of cancer by radiation, the fields of roentgen rays and radium do not overlap appreciably except in the administration of large external doses for deep penetration, when it is usually necessary for the sake of economy to employ roentgen rays. There is probably no difference between *x*-rays and radium, except that with radium we are apt to use heavier filtration than we do with *x*-rays, and are therefore certain to get sufficient penetration. A good dose of radium is better than a poor dose of *x*-rays and vice versa.

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CHAPTER IX

ULTRAVIOLET LIGHT

The therapeutic use of ultraviolet light in dermatology has received recent stimulus from active research. The use of x-rays and radium gradually developed the conception that therapeutic effects are associated with deep penetration. The research into ultraviolet energy has shown that therapeutic properties also reside extensively in a form of radiation whose penetration is slight. The volume of literature concerning the physical characteristics and experimental biological action of this form of therapy has been so great during recent years that the reader is referred to special text-books and pamphlets for detailed studies of these subjects, which are only briefly surveyed in this volume.

Sources.—Among the sources of ultraviolet light the *sun* holds a preeminent position although its contributions are meagre and variable. Sunlight contains only a small fraction of the shorter wavelengths suitable for therapy, and this fraction is the most influenced by altitude, sun position, weather condition, *et cetera.*

Carbon arc lamps are widely used as a source of ultraviolet light. If two carbon rods are connected in an electric circuit and the circuit is closed by touching the tips of these rods together, when they are separated the current continues to flow across the gap, forming an arc which produces light. Carbon is suitable for electrodes, because upon oxidation it forms a gas and therefore does not produce a deposit about the arc. On account of the poor thermal and electrical conduction of the carbon a high temperature is produced at the crater. It also gives a longer arc for a given difference in potential between the two poles than metals, as it is more easily disintegrated. In the electric arc a flame of luminous vapor fills the space between the electrodes and their ends become incandescent; in the horizontal position, this flame is the shape of an arc. Finsen employed a high voltage arc between solid rods of plain carbons, in which the positive carbon becomes extremely hot, reaching a temperature of 3500° C. At its extremity there is formed a cup-shaped depression known as the crater. The Finsen-Reyn lamp is an improved model. The negative carbon becomes sharply pointed; the positive one is usually made thicker than the negative one because in the open arc it would otherwise burn away more quickly than the latter. The efficiency of the radiation emitted depends upon the proper ratio between the amperage, the voltage, and the cross section diameter of the carbon. Only direct current is used because the principal benefits are derived from the light emanating from the white glowing crater of the positive carbon. The light of the arc itself contains very few important rays. The more the crater approaches a state of white heat, the more chemical light is emitted. Russell estimates that in the direct current open arc 85 per cent of the radiation is from the incandescent positive crater, 10 per cent from the negative carbon, and only 5 per cent from the flame of the arc itself.

There are three types of carbon arc lamps as viewed from a mechanical standpoint, the difference being the position of the carbons. They may be opposed to each other, end to end, which is the Finsen type of arrangement, or inclined at various angles, or may be parallel. The methods of striking the arc and feeding the carbon may be either manual, mechanical, or electrical.

With alternating current the polarity of the two carbons changes very rapidly, so that each is alternately the crater or the point; consequently the ultraviolet emanations come from the arc stream and the flame. All alternating current arcs are of low intensity, whereas the direct current lamps are of high intensity. The open flame arc lamp is simpler and less cumbersome than the Finsen lamp and is an efficient source of ultraviolet radiation.

The open arc type of lamp is operated with the arc exposed to the atmosphere. Another type is the enclosed arc lamp in which the arc is surrounded by a globe. This tends to retain, about the arc, air from which the oxygen has been burned. By the exclusion of oxygen the consumption of the carbons is retarded, the arc is made more steady, and unpleasant fumes are avoided. Enclosed arc lamps have the disadvantage that a certain portion of the radiation is absorbed by the globe, which is usually made of "Uviol," "Vitreosil," or "Vita." This absorption is more pronounced as the glass becomes fogged and "solarized."

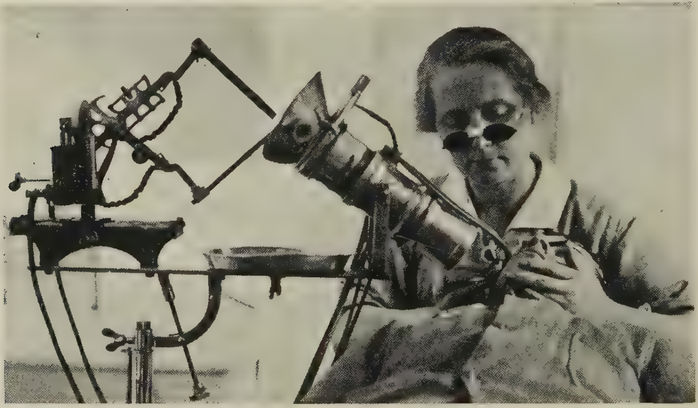

Fig. 123.—Finsen-Reyn carbon arc lamp. (Courtsey of Dr. Axel Reyn.)

The modern development of the carbon arc lamp has led to the use of impregnated or cored carbons in order to obtain more light from the arc itself. Carbons are generally manufactured by mixing carbon coke and lamp black with coal tar, which forms a thick paste, and this is made into rods by hydraulic pressure, and baked.

When carbon electrodes are impregnated with certain salts, the arc becomes very luminescent. This flame arc lamp produces considerably more light for a certain amount of electricity. Increased light from the arc is also given by substituting other materials for carbon in the electrodes. Cored carbons are constructed so that the crater tends to keep to an easily volatilized central zone. The core may be made of a metal such as iron, aluminum, and tungsten or a mixture of some of these with magnesium or calcium, or it may consist simply of a less dense form of carbon, or impregnated mineral compounds. Each of the different types has a spectrum of known characteristics. They offer a means of controlling the spectral energy distribution, and by their use it is possible to select and give the quality of ultraviolet radiation desired. Although there are many types of carbon available, three are especially important in dermatological therapy.

1. *Therapeutical N A Carbon.*—This carbon contains a fluoride and gives a bluish-white light. The energy produced is qualitatively a practically continuous spectrum, from the infra-red through the visible and ultraviolet zones to approximately 2800 Å. u. with scattered lines extending to wavelengths shorter than 2000 Å. u. The greatest quantity is in the short visible and near-ultraviolet regions, comparatively little of wavelengths shorter than 2900 Å. u. being emitted. The light from this arc will produce an erythema and eventually tanning, and is used in the treatment of rickets and on blondes who have no tolerance to short wavelengths.

2. *Therapeutical N B Carbon.*—This carbon contains iron and gives off visible light similar to that of the A carbon, although it has a candle power less than one fourth of the former. Light from this arc is in general more similar qualitatively to light from the quartz mercury arc, which is widely used in light therapy. It is especially rich in ultraviolet rays of wavelengths such as are produced by the mercury vapor arc in quartz. Quantitatively the amount of ultraviolet light from a therapeutical "B" arc is greater than from most mercury arcs because of the customarily larger electric energy consumption in the carbon arc. In therapy the B carbon holds an intermediate position between the A and C.

3. *Therapeutical N C Carbon.*—The C carbon gives the shorter wavelengths, with a large proportion of that part of the ultraviolet spectrum which is useful in the treatment of skin diseases. These wavelengths are the ones which possess pronounced biological and bactericidal properties.

The mercury arc is particularly rich in the rays of short wavelengths which have a rapid germicidal action. The radiation is distributed in a few intense emission lines, as some parts are weaker than the strong bands and only have time to register when the exposure is prolonged. There is only a small amount of infra-red radiation.

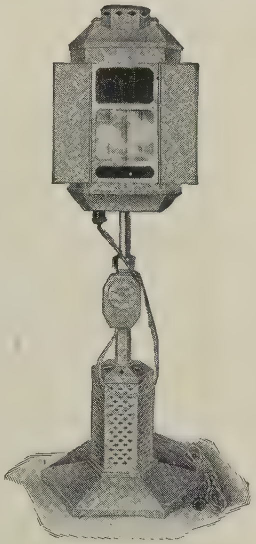
Fig. 124.—Small carbon arc therapy lamp for use in the home.

Operating conditions of the carbon arc lamps must be carefully regulated. As already stated, there is a proper ratio between amperage, voltage, and cross section diameter for each grade of impregnated carbon electrode. Burned out or burned back craters may result from improper voltage or amperage for the diameter of the carbons. The carbons should be dried before being used, because damp carbons will also cause the core to burn back. If the carbons are inaccurately set, a lip may form on the upper one. Mushroom ends are produced when the arc is too short. Spindling or pencilling usually denotes overloading, although either may be caused by dirt on the carbon holders. Sputtering may be produced by damp carbons or because they are improperly set or trimmed, or because the arc is too short. Carbons are porous and, having been baked at a high temperature during the process of manufacture, readily absorb moisture. It is a good habit to keep a set of unused carbons on the rheostat or in a warm place.

In 1901 an American engineer, Peter Cooper Hewitt, constructed the first *mercury vapor lamp*[1] for commercial use. Since that time the lamp has been greatly developed in numerous industries, as well as in medicine. At present the mercury arcs in quartz lamps are of two types—air-cooled and water-cooled.

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[1] Less important therapeutical sources of ultraviolet light are the enclosed incandescent bulb, the Edison carbon filament, the tungsten, the gas bulb and the magnetite arc.

The air-cooled lamp, being the more useful and less expensive, will be described first. It is a mercury vapor light produced within a vacuum quartz tube. Over the light is a hood containing diaphragms of various sizes. Each lamp is equipped with a rheostat, and some possess voltmeters. The hood and the lamp are usually mounted on a movable floor stand with a tripod base and with a rack and pinion device for projecting the hood horizontally away from the stand. The burner consists of an arc quartz tube with two transverse mercury containers to change the current, which is brought through beaded leads and mercury-sealed electrodes. Fan-shaped metal coolers are mounted on the mercury containers. These diffuse the heat generalized at the electrodes. The direct current burner has two electrodes, one positive and one negative. The alternating current burner has three electrodes, two positive and one negative.

The water-cooled type is a small lamp also usually mounted on a floor stand. From it the rays are projected through a quartz window. Between this window and the burner the heat rays are absorbed by circulating water. The direct burner is a ∩-shaped tube of transparent fused rock crystal quartz. To the ends are attached two mercury containers at right angles to the plane of the arc tube. These constitute the electrode vessels to which the current is conducted by ground-in, mercury-sealed rods. An arc is produced between the mercury poles and fills the entire length of the arc tube. In order to carry off the heat produced, the lamp is cooled by running water, which is separated from the arc tube itself by an evacuated quartz jacket, placed within a water tight metal casing. In front of this casing is a quartz window through which the rays are emitted. The alternating current burner is similar to that used for direct current, with the exception that the arc tube consists of an ∩∩ and is provided with three electrode vessels and three ground terminals. Lamps are equipped with proper transformers so that they may be used upon usual commercial voltages.

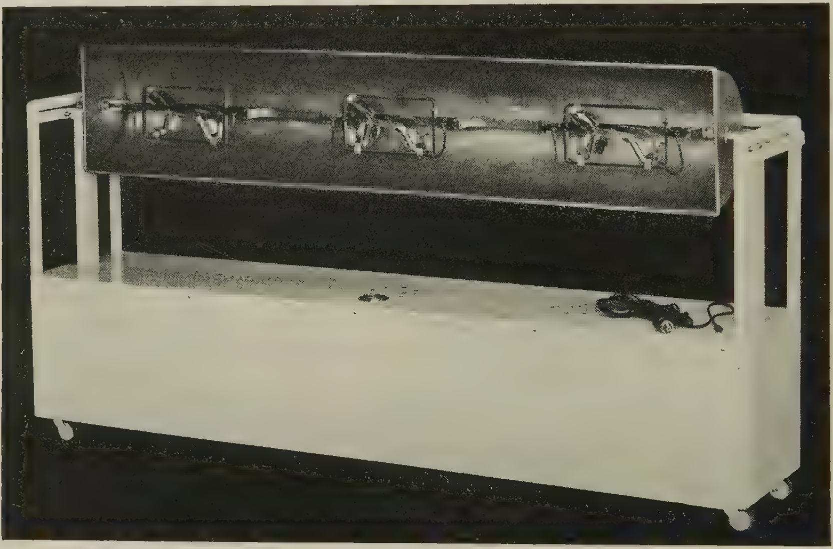

Fig. 125.—Triple-burner mercury arc lamp for generalized exposures. One of the burners can be used separately for restricted areas.

In some quartz mercury vapor burners the anode is made of coiled tungsten wire instead of liquid mercury. Coblentz has found that there is no appreciable difference in the ultraviolet component radiation from these two types of lamps when operated on the same energy input into the burner.

The statement has been made that the air-cooled and water-cooled mercury vapor quartz lamps vary somewhat in the wavelengths of the energy emitted. These differences are more apparent than real, for the mercury vapor arc lamp produces practically the same spectrum whether the lamp is air cooled or water cooled. Nevertheless, the presence of shorter ultraviolet rays from an air-cooled lamp is evidenced by the production of ozone, which is made by wavelengths of 1850 and 1900 Å. u. No ozone is detectable from a water-cooled lamp. Because of the cooling the water-cooled lamp may be placed closer to the lesion, and because of the shorter distance there is a relatively greater quantity than from the air-cooled lamp. Anderson estimates that on the basis of 28 per cent ultraviolet rays from the quartz mercury arc, only 6 per cent are shorter than 3000 Å. u. The clinical importance of these differences between the air-cooled and water-cooled lamps has, however, been exaggerated. There is actually no noticeable difference in the therapeutical action of the two types of lamps in dermatological conditions. As a matter of fact, the air-cooled and water-cooled lamps are interchangeable in the treatment of dermatoses. It is true that occasionally a small lamp is easier to apply to a limited surface than a large lamp, and there are numerous special applicators and filters for both lamps which serve certain purposes, sometimes making one form of lamp preferable to the others. Aside from these distinctions, other differences drawn between these two forms of energy can be discounted as being too small to produce changes in the clinical effects.

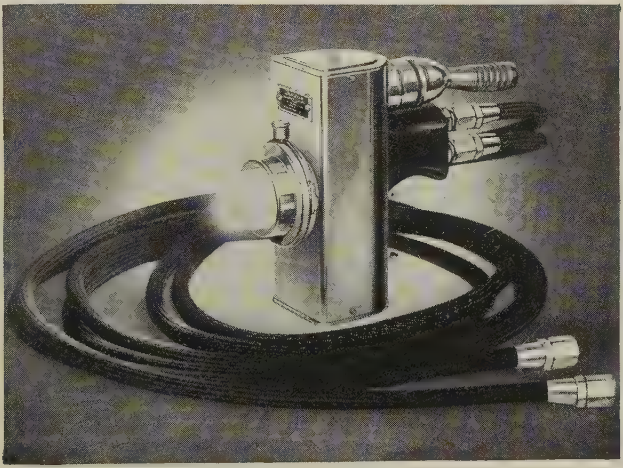

Fig. 126.—Water-cooled mercury vapor therapy lamp.

Physical Characteristics.—As in the case of *x*-rays and radium, ultraviolet light is a part of the spectrum of radiant energy. It comprises that portion with *wavelengths* approximately between 1000 and 4000 Å. u. This segment is situated next to the violet zone.[1]

Therapeutic carbon arc lamps produce rays within the visible spectrum and others which are longer and shorter. The output of ultraviolet is principally in the long wavelengths, and there is in addition an intense infra-red spectrum.

In general, the radiation from the white flame carbon arc resembles sunlight both in quality and relative distribution of ultraviolet, being weak in wavelengths less than 2900 Å. u. But the wavelengths (infra-red radiation) greater than 3000 Å. u., which are filtered out of the sun's rays by the atmosphere of the earth, form a large component. However, as Coblentz has pointed out, there can be no exact comparison of the radiometric measurements or of the therapeutic effects produced by the ultraviolet rays from the carbon and mercury arc lamps and the sun, because these sources are at different temperatures and have different spectral components. "The temperature of the positive electrode of the carbon arc is about 3300° C. The arc vapors from the electrodes of pure carbon, which are quite nonluminous, have a strong emission in the violet, while by using cored carbons a highly luminous arc is produced." The continuous spectrum from the highly incandescent crater of the positive electrode is added to the radiation from the arc vapors. Consequently there is an intense infra-red spectrum of longer wavelengths than from the sun.

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[1] See diagram, page 217.

Mercury vapor quartz lamps produce a visible spectrum consisting of several strong emission lines and a weak continuous spectrum beginning at 6300 Å. u., extending through the invisible ultraviolet to 2000 Å. u. or less, where the quartz light spectrum ends. Aside from the infra-red emission lines at 10,000 to 12,000 Å. u. the arc vapors emit but little infra-red radiation.

The ultraviolet spectrum from a quartz lamp consists of the wavelengths between 3800 and 2000 Å. u. It is further divided into near ultraviolet rays and far ultraviolet rays, the former consisting of comparatively penetrating wavelengths between 4000 and 3000 Å. u., and the latter of wavelengths between 3000 and 2000 Å. u. with slight penetrating power and considerable biological potency. These shorter wavelengths exert specific photochemical action.

The properties of reflection, penetration, and absorption depend upon the wavelength of the incident radiation and the exposed material. Biological reactions of erythema and pigmentation have been shown to result from radiation of a narrow component of the spectrum—from 3100 to 2300 Å. u. There is a pronounced maximum effect in the zone just below 3000 Å. u. This part of the spectrum which exerts a maximum biological effect has an extremely low penetration.

In a physical sense, the longer wavelengths produce molecular vibration and heat, whereas the shorter rays display largely an electronic action similar to that of *x*-rays, with resulting chemical and biological reactions before the residual fraction of energy is ultimately transformed into heat. The tissue is not affected biologically either by the energy reflected or by the part absorbed before reaching it, or by the part permeating it. Living tissue is only affected by the portion of energy absorbed in it. To elucidate the different biological effects of the various components of the ultraviolet spectrum, it is sometimes divided into:

1. Intravital rays, which pass through glass—3900 to 3200 Å. u.
2. Vital rays, which do not pass through glass—3200 to 2900 Å. u.—and seem necessary for the processes of animal life.
3. Extravital rays, which are less than 2900 Å. u.

The incident *intensity* of ultraviolet is greatest where the rays strike the surface at right angles. The amount reflected is increased in proportion as the incident ray assumes a direction less than 90 degrees. This loss by reflection is an important clinical consideration. *Reflection* is also determined by such salient factors as the complexion, part of the body exposed, age, race, and pigmentation. The degree of penetration of light of various wavelengths into the skin is not completely known, but visible light penetrates better than the infra-red and the ultraviolet light. The characteristics of the skin which influence reflection also affect penetration but to a greater degree; the latter being influenced additionally by the blood content of the derma.

A careful study of the *penetration* of ultraviolet radiation has recently been conducted by Anderson and Bird by means of fluorescent photometry. Examinations were made of the percentage transmission of monochromatic ultraviolet light through living rabbit's skin of 1.2 mm. thickness. The following table is published through the courtesy of these investigators.

TABLE 19

Wavelength.	Percentage transmission.			Average.
	Bird.	Fraser.	Anderson.	
Å. u.				
4045	16.0	16.0	16.5	16.0
3660	15.0	14.0	13.0	14.0
3130	8.4	10.7	9.2	9.4
3025	7.5	6.6	8.4	7.5
2800	10.1	9.4	9.8	9.8
2650	7.3	....	7.4	7.4
2537	6.3	7.1	6.3	6.6

Bachem and Kunz after extensive investigations have concluded that a radiation of more than 400 mμ should be used if pronounced penetration into the corium and into the subdermal layers is required, and that the wavelength 400 mμ is particularly suited to be absorbed in the blood capillaries and to affect the blood stream. A considerable percentage of the near ultraviolet at 250 mμ reaches the corium, 270 to 280 mμ are practically all absorbed in the epidermis, and no radiation shorter than 240 mμ reaches the living parts of the epidermis, all being absorbed in the dead horny layer of the skin. The results of the work of these workers showed less transmission than that claimed by Macht and Anderson.

However, the data obtained prove that the ultraviolet radiation emitted by the mercury lamp is much more penetrating through living skin and other tissues than has been hitherto supposed. Hasselbalch, whose previous study was one of the most extensive on the subject, states that the depth of penetration for the shorter ultraviolet rays through the skin is for the most part not more than 0.1 mm. Henri, in his work, states much the same thing, and Glitscher expresses the opinion in his contribution on the subject that light waves of less than 300 mμ are absorbed by the epidermis in a layer of 0.1 mm.

It is well to emphasize that these data were obtained only with living tissues, and interesting to note that the results harmonize finely with clinical experiments. The positive and undeniable clinical results obtained by ultraviolet irradiations in pathologic conditions could not reasonably be explained except on the assumption that the active ultraviolet rays penetrate deeply enough to affect at least the superficial capillary circulation. The depth reached is increased by the ischemia produced by compression with surface quartz applicators or other means. These rays will not pass to any extent through paper, cloth, glass, or ointments.

Investigations of the *transmission* of ultraviolet rays by various materials are made by spectrographs equipped with quartz lenses and prisms. Records are taken on photographic plates made more sensitive to the extreme ultraviolet radiation by previous treatment of them by oil. The spectrum may be observed through a piece of uranium glass which gives visibility to the otherwise invisible rays through the phenomenon of fluorescence. Sheard states: "Ordinary window glass does not transmit light of lesser wavelength than approximately 3200 Å. u. hence it fails to transmit the ultraviolet region of sunlight comprised between 3200 and 2900 Å. u. Recently, Lamplough of Birmingham, England, has introduced a new and fairly inexpensive glass, known as vitaglass, which transmits to the limit of sunlight in the ultraviolet region, although it does not transmit 100 per cent of each and all of these wavelengths in the ultraviolet regions. There is a loss of about 12 per cent of the energy transmitted by the greater wavelengths (7000 to 4000 Å. u.) on account of the reflection of light at the surfaces of the glass." The practical utility of vitaglass and other substitutes for window glass is limited by the meagerness of the fraction of solar ultraviolet which penetrates our atmosphere.

TABLE 20

Transmission of Radiant Energy (Visible and Ultraviolet) of Various Wavelengths by Vitaglass and Window Glass[1]

Wavelength (Ångströms).	Percentage transmission.		
	Vitaglass, clear, 1.7 mm. thick.	Vitaglass, cathedral, 2.6 mm. thick.	Ordinary window glass, 2.7 mm. thick.
6000	88	88	88
5000	88	88	88
4000	88	88	85
3700	88	88	70
3500	88	86	58
3400	85	84	45
3300	75	73	18
3200	65	60	4
3100	50	44	0
3000	35	32	0
2900	25	25	0
2800	12	10	0
2700	5	5	0

Transmission of light through any substance is always accompanied by a certain amount of *absorption*, regardless of the color or wavelength of the light. Absorption may be of two kinds: (1) General, in which it is almost the same for all wavelengths, and (2) selective, in which the absorption of certain wavelengths is much greater than that of others. "Only the radiation that is absorbed can effect chemical change."

A study was made by Schultze and Rothman to ascertain which parts of the human skin absorb radiation in the zone of 3000 Å. u. They found that ether extracts of the epidermis showed selective absorption of the ultraviolet rays of this wavelength, while watery extracts took up all wavelengths. The acetone soluble fractions of the ether extract were positive to transmission, and the acetone insoluble, negative. From these observations they concluded that the absorption of ultraviolet rays occurs through the nonsaponifiable acetone soluble lipoids of the upper layers of the human skin. Sonne influenced photographic plates through irradiated oils and gums, and Haxthausen supplemented this work by using skin fats that were irradiated.

It has been demonstrated that different parts of the cell absorb different quantities of ultraviolet energy.[2] The longer rays especially influence the nuclei of the cells they reach. As a result of extensive investigations upon plants and animals substantiated by microscopical studies of cross sections taken after exposure to ultraviolet radiation, Reiter and Gabór have recently shown that wavelengths within a small zone, about 340 mμ have a special stimulative action upon mitosis, wherefore these wavelengths have been designated mitogenetic. In larger doses, the shorter wavelengths principally cause changes of a coagulative nature in the ectoplasm and decrease its permeability.

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[1] From Sheard.

[2] Pacini, A. J.: Ultraviolet Radiation, J. Radiol., 3: 481–485, 1922.

Biological Action.—Following an exposure to ultraviolet light manifold visible and invisible biological changes occur, their onset being more or less related to the intensity of the exposure. When the dose is sufficient, an *erythema* ensues after an average of six to twelve hours. Such a reaction should not be confused with the caloric hyperemia, which one occasionally sees when the patient has been too near the lamp and subjected to the heat rays. The latent interval before the appearance of an erythema reaction, and the severity and duration are inconstant, but it is practical to distinguish four varieties, respectively designated first, second, third, and fourth degree (see page 226).

Short exposures of ultraviolet radiation produce an acute inflammation of the skin. The onset is often revealed by an abnormal sensitivity, especially to the friction of clothing. There is a vasodilatation followed by hyperemia, slight edema, and probably stimulation of cell nutrition. A rather intensive inflammatory reaction and prolonged hyperemia result from longer exposures, or more severe inflammation may be induced. Occasionally urticarial manifestations are observed. Saidman has seen a distinctly hemorrhagic reaction in a case of carcinoma.

Any procedure that can cause a hyperemia of the skin is evidently able to increase the effect of the erythema-inducing radiations. The reaction is more marked after heat or massage. Because the infra-red rays cause vasodilatation, the carbon arc radiation induces a rapid hyperemia and is often used preliminary to exposure to the mercury arc.

More severe reactions may be accompanied by edema, especially of the eyelids or limbs, and an elevation of local temperature. Subsequently the affected skin becomes dry, wrinkled, and roughened. With still stronger reactions blisters containing a colorless or yellowish serum appear, but only after a latent period of some twenty-four to forty-eight hours. They require several days to heal, the evolution being always uneventful. A slight redness may persist for some days, which is brought out particularly by factors that activate the cutaneous circulation (heat, massage, emotion). The average reaction is mitigated after two to four days and is followed by a desquamation of the epithelium.

Various systemic effects which have been noted after generalized erythematous reactions are attributed to the radiation. Stimulation of physical and psychical forces, pruritus, enervation, insomnia, menstrual irregularities, tachycardia, and headache have been observed. On the other hand, mental relaxation, analgesia, the induction of sleep, and relief of pruritus have also been noted. The variations in systemic response are accounted for by individual characteristics and the intensity and frequency of the administration.

As a result of ultraviolet radiation there is an increased *physiologic activity of the skin* especially noticeable in the circulation, the sweat secretion, and the protective development of pigmentation. In tanned skins acne is infrequent. In addition to this general increase in tone, the radiation has a pronounced action upon the cutaneous nerves. Small doses are generally soothing, antipruritic, and analgesic; they induce slumber and relieve itching. In isolated instances, however, especially in cold weather, itching seems to be increased instead of relieved by ultraviolet therapy. This is probably due to an error in dose, but in rare cases unsatisfactory results even from well-judged treatment of pruritus are to be expected. Unduly prolonged exposures, particularly in blondes, often lead to irritability and restlessness. Nagelschmidt is inclined to explain the systemic effects of ultraviolet light by an irritation of the cutaneous sympathetic branches of the nervous system, leading to an imbalance between this and the parasympathetic system, and to changes in the internal secretions.

Therapeutical results seem to depend mostly upon the erythema-producing rays. Through the researches of von Hausser and Vahle and Perthes, it has been shown that erythema from mercury vapor lamps is brought about entirely through certain wavelengths (300–290 mμ), and that an acquired immunity to these and to no other wavelengths protects against them all. According to Biancani, repeated irritations of the skin by ultraviolet rays cause *chronic* lesions which are often precancerous. Sunburn, freckles, eczema, hydroa, keratosis senilis, and xeroderma pigmentosum are manifestations of the reaction of the skin to the ultraviolet rays of the sun. The effect is less pronounced in dark skins, namely, in brunettes or in members of the colored races.

Substances such as eosin, hematoporphyrin or acridin on being introduced into the organism render it more sensitive to the sun's rays—*photosensitization.* The phenomena of pellagra may possibly be due to this property, an endogenous toxin causing the sensitization. Some medicinal eruptions and eruptions in infectious diseases possibly can be ascribed to photosensitization. Hepatic insufficiency occasions the appearance of photosensitizing substances in the blood such as acid amines, tyrosin, and tryptophan. *Hypersensitiveness* to the rays is observed sometimes in tuberculous persons and in pregnant women. Irritation of the skin from ultraviolet rays can be averted by applying a cream containing quinine or sodium naphthosulphonate. Applications of tannin incorporated in petrolatum or alcohol (1 : 10), or resorcin lotions are effective. Ultraviolet exposures repeated at short intervals may possibly immunize the skin against irritation from the rays.

Pigmentation is common but evidently does not always run parallel with erythema production, the former seemingly being produced by radiations with greater wavelength than 320 mμ and even by infra-red rays. Unaccountable variations occur in different individuals. Some patients pigment well, some merely freckle, others pigment not at all or only slightly. Pigmentation from actinic influence results from the presence of increased amounts of melanin[1] in the germinal layer of the epidermis. It is mostly intracellular. The pigment protects not only the derma against ultraviolet rays by absorbing a fraction of the rays, but also the blood against overheating from the energy of light changed into heat.

Dorno studied the effects of sun and quartz light erythema and pigmentation upon twenty-five persons of different races, ages, and sexes by exposing a small field on the inner upper arm systematically to these forms of light at different seasons of the year with meterological records of temperature and wind altitude. From this exhaustive work it was very evident that the races having the darkest skins reacted strongest and red-haired people a little more than the ash blondes, which were the weakest. Children and juveniles were more susceptible than grown-ups and especially older persons, and also in them the pigmentation in brunettes was stronger than in blondes. All erythemas, except very weak ones, were followed by pigment. Pigmentation without a preceding erythema was not observed. I have observed persistent

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[1] Verne, J.: La Pigmentation et les Rayons Ultraviolets, Médecine, 8: 666–672, 1927.

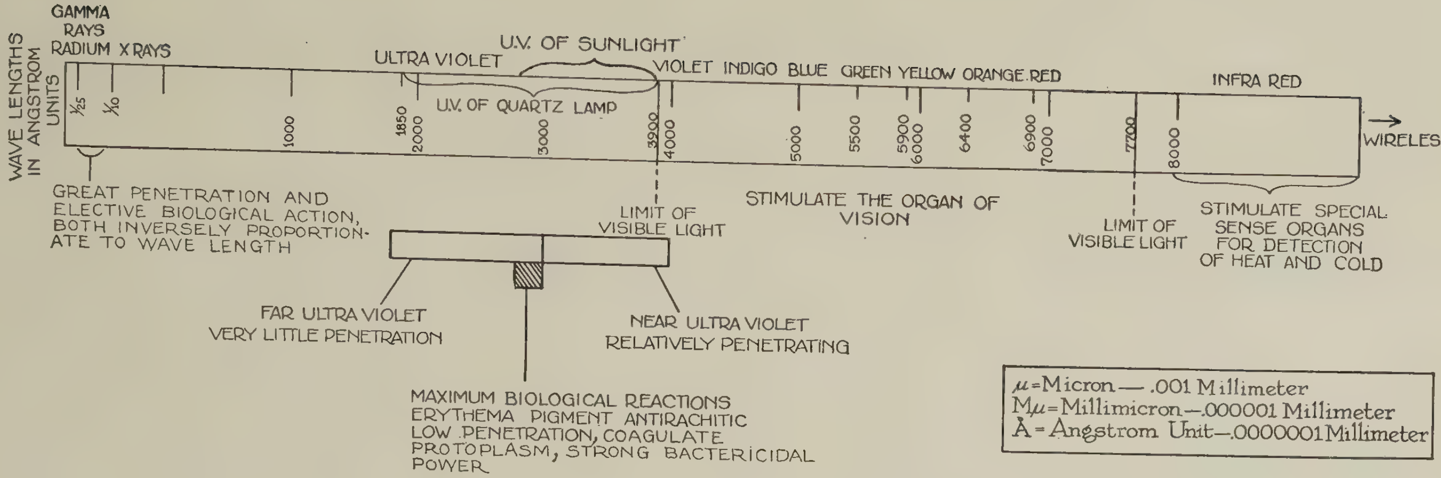
WAVE LENGTHS IN ANGSTROM UNITS
GAMMA RAYS
RADIUM
X RAYS
1/25
1/10
1000
1850
2000
3000
3900
4000
5000
5500
5900
6000
6400
6900
7000
7700
8000
ULTRA VIOLET
U.V. OF SUNLIGHT
U.V. OF QUARTZ LAMP
VIOLET INDIGO BLUE GREEN YELLOW ORANGE RED
INFRA RED
→ WIRELESS
GREAT PENETRATION AND ELECTIVE BIOLOGICAL ACTION, BOTH INVERSELY PROPORTIONATE TO WAVE LENGTH
LIMIT OF VISIBLE LIGHT
STIMULATE THE ORGAN OF VISION
LIMIT OF VISIBLE LIGHT
STIMULATE SPECIAL SENSE ORGANS FOR DETECTION OF HEAT AND COLD
FAR ULTRA VIOLET VERY LITTLE PENETRATION
NEAR ULTRA VIOLET RELATIVELY PENETRATING
MAXIMUM BIOLOGICAL REACTIONS ERYTHEMA PIGMENT ANTIRACHITIC LOW PENETRATION, COAGULATE PROTOPLASM, STRONG BACTERICIDAL POWER
μ=Micron — .001 Millimeter
Mμ=Millimicron — .000001 Millimeter
Å=Angstrom Unit — .0000001 Millimeter

Fig. 127.—Biological effects of various wavelengths.

pigmentation of more or less permanent character resulting from thirty seconds' exposure of the forearm to a water-cooled lamp two years previous. It is necessary to bear in mind the possibility of persistent pigmentation in the treatment of patients who are brunettes. Hausser and Vahle established that the wavelengths which most readily excite pigmentation are about 2975 Å. u.

Measurements of the influence of pigmentation upon the amount of ultraviolet light reflected by the skin have been made by Kartschagin. He concluded that there is a great difference between the amount of the radiation falling upon the organism and that taken up by it. However, ultraviolet radiation enters into the tissues in a large measure, from 87 to 92 per cent, depending upon the degree of pigmentation. It is generally known, of course, that once the exposure to radiation results in the tanning, further exposures to the same zones of light are less likely to cause any erythema.

Changes which are manifest *microscopically* are vascular dilatation and congestion, accompanied by edema of the derma which may produce subepidermal vesicles or extend into the epidermis; thickening of the germinal layer with increased deposit of pigment in the cells of this layer, and swelling of the prickle-cell layer. The sensitiveness of the cells to ultraviolet energy is proportionate to their immaturity and differentiation. It is apparently similar to that of *x*-rays and gamma rays, in which young or undifferentiated cells are more susceptible than adult or highly differentiated ones.

According to Rost, the cornified epidermis, which contains no living protoplasm, may be said to have no photobiological processes, excepting fluorescence. In the granular and mucous layers such effects may be assumed and, in fact, may be noted after large doses. Keller found the most notable effect of ultraviolet light to be a degeneration of the prickle cells shown by pyknosis of the nuclei and by a contraction and coagulation of the protoplasm. The germinative layer is especially reactionary and shows pigmentation after comparatively slight exposure. Jesionek believes the light acts as a germinative, keratoplastic and pigmentophoric stimulant upon the basal cells.

Perhaps even more sensitive than these cells are the endothelial cells of the capillaries in the papillary bodies. Shortly after small exposures dilatation of these vessels can be seen. The other cells of the corium and subcutis possess no special susceptibility to light, so far as is known, and the effects upon the sebaceous and sweat glands, the end organs of the cutaneous nerves, and the blood circulating within the capillaries remain subjects for study.

The *immunity* against radiation is thought to be cellular according to the researches of certain authors—Perthes, Timm, Teilhaber. It is considered humoral by Kok and Vorlaender. Perthes believes that antibodies are formed against the effect of light somewhat similarly to the formation of antibodies against poison in the realm of general immunity. By careful radiation he obtained a high degree of immunity without the production of pigment.

The *bactericidal* power of ultraviolet is a recognized characteristic. Bayne-Jones and Linden determined that this effect of ultraviolet light coincides roughly with the absorption spectrum of bacteria. From measurements by Henri and Burge it was also found that the curve of bacterial sensitivity to ultraviolet coincides closely with the curves of absorption by egg albumin and serum. These results might be expected according to Grotthus' law that only the light absorbed produces a chemical effect. This direct effect is supposed to be due to a coagulation of the protoplasm, similar to that produced by heat.

In the opinion by Coblentz and Fulton, the germicidal action is apparently produced by ultraviolet radiation throughout the spectral range, extending from the very short wavelengths (Schumann rays) to and including 3650 Å. u. The shortest rays have the most violent lethal action, which decreases in intensity with increase in wavelength. Browning and Russ found that the germicidal action is mild for 2100 and 2960 Å. u., and strong for 2540 and 2800 Å. u.; Bovie considers the bactericidal action strongest from 2500 to 3000 Å. u. Nagelschmidt points out that this action belongs to a very narrow zone while other spectral parts have an action which is infinitely less. Mayer and Dworski, and Howze have determined that ultraviolet rays are bactericidal for the tubercle bacillus after an exposure of three to five minutes at a distance of 5 to 10 inches from the burner. Guinea-pig inoculations were used as controls. Friedland-Kasan found tubercle bacilli *in vitro* completely sterilized by an exposure of one to one and one half hours to either the carbon arc or mercury vapor lamps, which were each equally effective. Takahashi and Takemura could prevent the further growth of Trichophytons only by very long irradiation.

According to Coblentz and Fulton, about 6 per cent of the total radiation emitted from the quartz mercury arc is of wavelengths shorter than 290 $m\mu$, which have high germicidal action. This radiation of short wavelengths with maximum bactericidal effect has an extremely low penetration. These rays are completely absorbed by human skin and cannot penetrate very deeply into the body. Coblentz and Fulton have shown that the energy value of the most active germicidal radiation from the quartz mercury arc of wavelengths 170 to 280 $m\mu$ required to kill a bacterium is very small, being of the order of 19×10^{-12} watt or 4.5×10^{-12} g cal.

In the human skin, however, there is not a direct exposure of the bacteria, as in the above experiments. Here there are marked variations in the bactericidal power because of the low penetrability of the shorter wavelengths which prevents them from reaching the bacteria. Since the radiation is absorbed by the protoplasm, the bacteria not on the surface are protected. This is a great source of disappointment in dermatological therapy. The author has never clinically obtained any noticeably direct bactericidal action from ultraviolet light.

If ultraviolet radiation of the proper wavelength is applied to an infected wound, theoretically the pathogenic organisms on the surface are directly killed. Moreover, the passage through the tissues of the longer ultraviolet wavelengths and luminous rays which penetrate to a greater depth, may be accompanied by beneficial effects upon the protective mechanism. There is, however, no evidence that organisms not directly upon the surface can be affected by ultraviolet rays of wavelengths known to possess powerful bactericidal action, that is, in practical work this lethal action does not extend deep enough to be of clinical value. This holds true even in impetigo. The clinical failure of this direct bactericidal action is the chief reason that the differences in the water-cooled and air-cooled lamps for clinical purposes have seemed exaggerated, and that the air-cooled lamp can in every case be substituted for the water-cooled lamp with complete satisfaction.

However, even if the direct bactericidal action is clinically of negligible value, the inflammatory reaction which results from the production of an erythema is very effective in the curing of infectious diseases. In his early work, Finsen attained cures of lupus by the carbon arc, with the production of an erythema. The carbon-arc spectrum is very rich in the longer ultraviolet rays, and deficient in the shorter ones which have most pronounced bactericidal effects. Sequeira states that it is the inflammatory reaction rather than the direct lethal action that kills the tubercle bacilli in lupus vulgaris.

The therapeutic benefit of ultraviolet radiation in *systemic conditions* seems to depend largely upon its influence on the metabolism of calcium, iron, and phosphorus.

In conditions due to calcium deficiency the oral administration of calcium lactate does not seem to secure its complete or rapid assimilation without the use of ultraviolet radiation. In this regard actinic radiation serves as a catalyzer, augmenting the calcium and the phosphorus content in the blood. This is especially beneficial in the treatment of rickets, the wavelengths between 302 and 313 mμ, possessing a specific influence.[1] This form of therapy has been successfully employed in tetany. The administration of calcium salts and the parathyroid gland by mouth during the course of treatment should be prescribed, although it is not necessary.

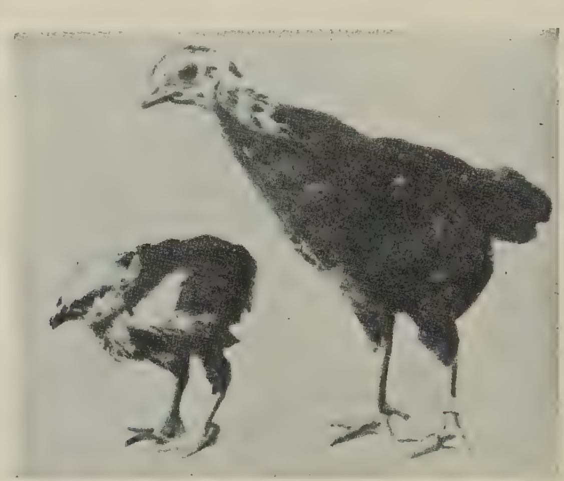

Fig. 128.—The smaller chicken received only sunlight which had passed through ordinary window glass, whereas the larger one received in addition ultraviolet light from a mercury vapor lamp. (Courtesy of Dr. W. T. Bovie.)

Cholesterol becomes endowed with antirachitic power in some unknown manner through the absorption of ultraviolet radiation. Similar changes are produced in cod liver oil and many food products such as milk, vegetables, and greens through activation of substances contained in them by ultraviolet light. Antirachitic power through some such activation by ultraviolet rays is accounted for, in the opinion of many physiologists, by the discovery of vitamin D. At the present time sufficient information is not available to describe further the nature of the photochemical changes which the vitamin induces. We only know that this factor in some way meets defects of composition in diet by raising the potential of cellular activity, and this results in the efficient utilization of those substances essential for a proper growth and development of the organism.

The stimulating action of light upon the *growth* and *development* of plants, as well as animals, is a subject of general cognizance, and interesting experiments with radiant energy have demonstrated the vast importance of this subject.

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[1] Hess, A. F., and Wienstock, M.: A Study of Light Waves in Their Relation to Rickets, J. A. M. A., 80: 687–690, March 10, 1923.

The reader can do no better than to refer to the excellent article by Bovie for examples of the effects of ultraviolet light upon the growth and differentiation of tissue. He divided 250 chickens about a week old into groups and confined them separately in a greenhouse from which the plants had been removed. Studies were made of the effects of different foodstuffs added to the regular chicken food and of exposures to sunlight and artificial ultraviolet light produced by a mercury vapor lamp. The foregoing illustration demonstrates the effects on growth and bone formation caused by exposure to light. Both chickens had the same diet.

Technic.—Before the rays are applied, the skin should be cleansed thoroughly with tincture of green soap followed by the application of alcohol, and wherever possible scales and crusts should be removed as these intercept the ultraviolet rays. Healthy skin should be protected during the treatment. The patient is placed so that the ultraviolet rays strike the surface under radiation perpendicularly.

As a preliminary measure to ultraviolet therapy, it is necessary that the lamp shall have been lighted long enough to have reached a steady state. Radiation from the mercury arc lamp before it has been lighted for ten minutes is weaker than at its steady value, but the efficiency of the carbon arc is reached and maintained in a much shorter time.

Air-cooled mercury arc lamps are intended for general body radiation or for the treatment of large areas. To avoid undesirable effects upon the skin due to excessive heat, the burner is always placed at a distance of at least 6 inches. The apertures in the hood covering this type of lamp permit distance raying of small areas. Compression treatments may also be given with the air-cooled lamp by the use of special applicators, with the lesion placed an inch or two from the lamp hood. For compression treatments of small lesions the water-cooled lamp is particularly useful, as the heat rays are absorbed by running water which circulates in a jacket around the burner. It may also be placed at distances up to 6 inches. A time clock is set to give the alarm when the treatment is finished.

The carbon arc therapeutic lamps are attached to a movable arm on a tripod stand and from this position may be used for the illumination of extensive surfaces or for light baths, the patient lying on a couch at 30 inches distance. The scalp is irradiated by having the patient sit in front of the lamp, facing it, with the head bent forward and resting on his hands or a table. Metallic cones of various sizes are attached over the opening in the lamp hood to restrict the field of illumination and localize the effects on small lesions.

During application it is extremely important that the eyes of the patient and operator, and all others within radius, have *protection* by suitable goggles to prevent injurious effects on the conjunctiva and retina by the irradiation. Goggles with side shields are recommended. Conjunctivitis produced by neglect of such protection usually manifests itself four or five hours after exposure. It is often exudative, with burning and pain lasting for several days. Retinal fatigue, ciliary body fatigue, and headaches are caused by indiscrete exposure. The treatment of these conditions should be complete rest of the eyes, frequent cleansing with warm boric acid solution, and the application of borated vaseline to the eyelids at bedtime.

When small skin areas are treated, the surface about them may be shielded by black cloth, paper, or sheet-lead. Adhesive plaster strips are exceedingly useful to circumscribe a small area exactly and give protection at its periphery. Parts outside of the adhesive plaster are shielded from exposure by some dark covering. In the treatment of women who are wearing thin or lacy apparel further protection should be given. Ultraviolet energy is so readily absorbed that shielding with almost any substance will limit the reaction to the area exposed. It is important to remember to cover the genital organs while giving general body radiation, as well as the breasts of female patients, as these areas are unusually sensitive portions. MacCormac and McCrea describe an accidental ultraviolet burn of alarming extent.

Caution must be observed in the application of ultraviolet light to atrophic, deeply infiltrated or fibrotic skin because severe reaction often results in indolent ulcerations. This admonition which was mentioned by Lane in the treatment of skin scarred by tuberculosis and *x*-rays has been supplemented by an instance in the author's practice in which a patch of morphea over the pectoral region was treated with the water-cooled lamp under pressure for two minutes. The resulting vesiculation rapidly produced a deep ulcer, which required dressings for three months before healing occurred. Colquhoun has reported a case of keratosis and fixed pigmentary deposit following quartz light therapy.

Different operating currents cause *variations* in the radiation efficiency of the mercury arc lamps. Peterson has found that for small variations about the normal operating current the ultraviolet intensity is approximately proportional to the square of the electrical power.

The arc tube should not be allowed to become clouded from use by deposits either on the inside of it or from the circulating water. Clouding of the arc tube materially reduces the intensity of the ultraviolet radiation. When using carbon flame arc lamps one does not have the factor of diminishing low or short wavelengths due to the gradual reduction of the penetrability of the quartz envelope of the mercury arc.

Blue uviol glass filters are used to cut off the red and heat rays and the ultraviolet rays of short wavelength, permitting, however, the blue, violet, and long-waved ultraviolet rays ("chemical rays") to penetrate. A red filter transmits chiefly the heat rays, while a water filter serves for their complete elimination. The intensity from the source is diminished in its passage through all filters by the amount absorbed by the filter.

Compression.—Compression with the water-cooled lamps is used in the treatment of deep-seated lesions or lesions of the mucous membranes. As the red blood corpuscles absorb the radiation, the object of compression is to produce a local ischemia through the pressure of the quartz lens upon the tissues. This dehematization enables the ultraviolet rays to penetrate into the deeper strata instead of being absorbed by the blood in the surface capillaries. The quartz lenses are made in various sizes to accommodate a variety of skin lesions. In addition, tubular applicators are employed to localize the radiation to small areas upon the skin or within the body orifices. A simple method which is used to avoid burning the healthy skin surrounding the lesion under treatment is to protect it with adhesive plaster or paste, as explained under protection. Some operators prefer, in the treatment of deep skin lesions, to use a blue window to reduce surface reaction to a minimum in order to increase to a maximum the dosage which can be administered to deeper structures. This blue window eliminates the heat rays and the shortest ultraviolet rays. The time of exposure with the blue filter is about four times that with the white light.

Distance Radiation.—It is important to recall that the law of inverse square distance also applies to ultraviolet light. This law is discussed in Chapter VI and on page 228 of this chapter. For practical purposes the intensity of the irradiation of a surface varies inversely as the square of the distance from the source to the surface.

Small Lesions.—Lesions which are small may be irradiated through the adjustable diaphragm of air-cooled lamps, usually at a distance of 5 or 6 inches from the hood to the skin surface. When the distance is less, the heat, especially of the carbon arc lamp, causes discomfort. Tubular applicators, as stated, may be used to localize the radiation to the lesion, or the area under treatment may be otherwise shielded to protect the surrounding normal skin. When the mercury arc lamp is used, it is so placed that the arc tube burner is parallel with the surface under treatment.

Small lesions are irradiated from a distance by the water-cooled mercury arc lamp by placing the lesion at $2\frac{1}{2}$ inches from the quartz window. For this purpose it is also convenient to use tubular localization applicators, which, in addition to insuring the correct distance, cut off the light from the surrounding healthy skin and from the patient's eyes.

Fig. 129.—Treatment of tuberculosis by sunlight. (Courtesy of Dr. A. Rollier, Switzerland.)

Large Areas.—For the treatment of large lesions and extensive areas the lamp is placed at a greater distance, usually beginning at 30 inches and being reduced as the tolerance is established. The minimal distance used for such treatment is about 10 inches. Alterations in distance affect the intensity nearly in accordance with the inverse square law which applies to a point source of energy.

General Body Radiation.—In the treatment of widespread dermatoses and where constitutional effects are desired, generalized body radiations are suggested. One of the principal indications for these light baths in dermatology is in the treatment of cutaneous tuberculosis. The patient is placed upon a flat couch, the body being entirely naked. The eyes are protected either by goggles or small wads of cotton placed over them. The delicate skin about the genitals is shielded by a towel, and in the treatment of women the nipples are covered. With the single burner mercury arc lamp, placements are made over the middorsal regions and over the flexor aspects of the knees. These two dorsal exposures are allowed to overlap on the buttocks. After these treatments the patient is rotated and the placements are made over the sternocostal angle and the front of the knees. In children this technic is varied, as it is possible to cover their entire body surface by one exposure to the front and one to the back.

Multiple burner mercury arc lamps are built so that general light baths can be given rapidly in either the standing or reclining position. There are three burners, each upon a separate circuit, arranged so that one is opposite the shoulders, one opposite the hips, and another at the ankles. The central burner is weaker than the terminal ones, as otherwise there would be excessive irradiation of the midtrunk due to overlapping. When the illumination is turned on, the bather slowly rotates the body in front of the lamp.

The larger clinics abroad, and more recently in this country, are provided with rooms specially equipped for general light baths. Several carbon arc or mercury arc lamps are arranged about the walls and ceiling, so that the whole room is equally illumined. The nude and goggled patients either lie on tables, walk about, or play games in the lighted room under the supervision of an attendant.

Quantitative Measurements.—From a clinical standpoint, quantitative estimations of ultraviolet output from the various therapeutic sources, which have already been described, have lacked uniformity and completeness. Although many excellent reports from pure physicists are to be had, these are too complicated for comprehension by those engaged in clinical work, or they involve conditions not encountered in practice. On the other hand, the commercial literature of manufacturers of therapeutic lamps abounds in apparently conflicting statements. Percentages are given without a statement of what constitutes 100 per cent. "Thus, for example, the mercury vapor arc in quartz has been said to give 66 per cent ultraviolet; in another instance the ultraviolet has been stated to be 28 per cent. Both are correct. In the first instance, the total radiation (100 per cent) upon which the percentage was based comprised radiations from 1850 to 14,000 Å. u. In the second instance, the total radiation measured was from 1850 to 40,000 Å. u."

Quantitative measurements of ultraviolet light from therapeutic sources have been made by Goodman, using 2450 Å. u. as the ultraviolet limit, because the sources investigated did not emit shorter radiations of appreciable intensity. His figures, obtained by a thermopile and galvanometer, are given in Table 21.

The possibility of clinically measuring ultraviolet radiation[1] by a simple *nonphysiological* standard naturally arises. Four plausible types of reactions present themselves: (1) Fluorescent photometry; (2) photochemical reactions; (3) photoelectric currents in voltages, and (4) the optical sensitivity of selenium.

Anderson and Gordon found that the fluorescence of certain substances excited by ultraviolet radiations can be matched by a variable comparison light source. This provides a fluorescent photometer which, after calibration, serves as a simple and reasonably accurate means for measuring the intensity of ultraviolet light from a light source. The light

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[1] Coblentz, W. W.: Methods of Measuring Ultraviolet Radiation, Radiol., 10: 116–121, Feb., 1928.

TABLE 21

Ultraviolet Units in Ergs Per Second Per Square Millimeter of Area at Forty Inches from the Source

Type of arc lamp D. C. current.	Arc voltage.	Arc amperage.	Arc length, mm.	Intravital 4000–3200.	Vital 3200–2900.	Extravital 2900.
Quartz mercury arc (used 200 hours)	75	3.4	55	10.981	8.585	4.034
A. C. quartz mercury arc (3 electrode type) (not rectified)	150	5.0	120	9.380	11.313	6.286
White flame						
Therapeutic carbon "A"	35	17.0	15	7.803	1.120	0.407
Therapeutic carbon "B"						
Blue flame "iron"	35	16.0	13	6.635	2.199	1.441
Carbon "C"; nickel						
Iron, aluminum	43	16.0	8	18.661	6.106	3.197
Carbon "E"						
Red flame						
Strontium fluoride	40	16.0	10	5.188	1.534	0.577
Carbon "F"						
Tungsten	38	16.0	7	7.332	1.855	1.228
Carbon "G"						
Nickel	40	16.0	11	10.108	2.441	0.668
Carbon "H"						
Yellow flame						
Calcium fluoride	40	16.0	12	4.296	1.215	0.439
Carbon "K"						
Cobalt	40	16.0	15	13.651	1.663	0.763
Carbon "A"	42	8.0	10	4.274	0.593	0.213
Carbon "B"	41	8.0	12	0.516	0.180	0.118
Carbon "C"	42	8.0	8	1.919	0.601	0.329
Carbon "E"	40	8.0	18	0.714	0.235	0.094
Carbon "G"	41	8.0	3	1.644	0.363	0.099
Carbon "H"	40	8.0	13	1.173	0.326	0.118
Carbon "K"	40	8.0	5	2.221	0.261	0.130

emitted by fluorescent substances is of such low intensity when compared to the light from lamps or natural daylight, that it is necessary to observe it in darkness or in dimmed illumination.

"Since all practical methods for producing ultraviolet radiations also produce visible light, it is necessary to enclose the fluorescent unit of the photometer in a light-tight container provided with a filter which transmits the exciting ultraviolet, but not the visible light from the light source. The best available filter is purple Corex, G986A. . . . In addition to the ultraviolet it transmits a little of the violet, red, and infra-red. It is absolutely opaque to yellow and green light.

"The most suitable fluorescent material for a practical photometer appears to be uranium glass. . . . It is especially well adapted for use with the purple Corex, for it responds to all the ultraviolet wavelengths transmitted by the Corex and emits in the yellow-green to which portion of the spectrum the Corex is completely opaque. This latter feature enables accurate observation of the fluorescent light.

"Variations in the transmission of the ultraviolet filter and in the responsivity of the uranium glass cause the intensity of the observed fluorescent light to be dependent not only upon the intensity of the ultraviolet source but also upon the spectral distribution of the ultraviolet energy in the source. This latter necessitates that a photometer comprising these units, Corex filter and uranium glass, be calibrated against each type of light source with which it is to be employed. . . . It is possible to calibrate a standard instrument and refer other instruments to this standard."

Pohle has experimented with a photochemical reaction, namely, the liberation of iodine (Keller test), which is based upon the effect produced in an aqueous solution of hydriodic acid by ultraviolet light. It is precise and fairly simple; but as the reaction goes on differently in different wavelengths of light, its usefulness at present is limited. For clinical purposes Pohle has suggested the designation "ultraviolet unit" for a medium erythema dose equivalent to the end-result of the Keller test.

A tumbler, 5 cc. in diameter with 100 cc. capacity, is filled with 25 cc. of a 1 per cent potassium iodide solution, 25 cc. of 5.3 per cent sulphonic acid, from 6 to 8 drops of a 1 per cent starch solution and 1 cc. of 1/400 normal sodium thiosulphate solution. This solution is placed within half the therapeutical exposing distance and left until it turns blue. After one or two minutes blue clouds begin to form in the solution, which should be stirred by a glass rod. The end reaction is easy to recognize. This defines one ultraviolet unit.

Dorno has described the advantages of a cadmium cell in uviol glass, which approximately simulates the erythema sensitivity of the skin to various wavelengths. The same metal in quartz was advocated by Szilard. Measurements by photoelectric currents must also comprise proper estimation of the wavelength sensitivity of the cell. The extreme sensitivity of the selenium cell to visual light obscures its reaction to the ultraviolet mercury lamp. Pohle and Sawyer found that the cadmium cell gives a satisfactory reading of the erythema producing part of the mercury vapor spectrum, and proposed a method by which the calibration of a photoelectric cell in absolute units can be carried out.

"The test with lithopone, suggested in 1924 by Dr. Janet Clark of Johns Hopkins for the dosage of ultraviolet light was developed by Dr. A. H. Pfund, who made a careful study of the sensitivity of lithopone to ultraviolet light. It was found that a light-sensitive lithopone paint was darkened on exposure to ultraviolet light, at a rate which was comparable to the rate of various physiologic reactions to ultraviolet light. It was found that lithopone is practically insensitive to wavelengths longer than 320 microns, and that from 300 to 230 microns the sensitivity is practically uniform.

"The method which has been used in these tests follows closely that suggested by Dr. Clark. An amount of lithopone powder, perhaps about the quantity which would be contained in a 10-grain (0.65 Gm.) capsule, is placed on a piece of glass. About 3 or 4 drops of water are added to make a moderately thick paste. This is stirred up with a glass rod, in order to break up the lithopone powder and get rid of bubbles, and a piece of transparent quartz is pressed down on the lithopone, thus pressing the lithopone paste out into a smooth even layer. These two slides are held together by rubber bands and then exposed to the ultraviolet light with the quartz side facing the light. For the sake of uniformity, these tests were all made at a distance of 20 inches except as indicated. Strips of this lithopone paste are exposed through the quartz glass to the ultraviolet light for successively longer exposures. In testing a new lamp, the first strip may be exposed for thirty seconds, and the time increased by ten seconds for each strip until the end of the slide is reached. The different shades of gray thus obtained are then compared, as Dr. Clark suggested, with a piece of gray paper which has a definite reflection factor of 50 per cent. This comparison must be made immediately, for a change in the darkened color of the lithopone occurs rather rapidly. A stop watch renders the test easier of application and a much truer color value is obtained with daylight than with artificial light. As a definition of one lithopone unit, she has proposed the time required to darken the lithopone to a reflection factor of 50 per cent—in other words, the time necessary to darken the lithopone sufficiently to just match the test color. She further stated that this time, multiplied by the factor 2.1, produces a just perceptible erythema on the average skin, and called attention to the facts which I have already quoted—the variation of the erythema in persons and in the different parts to be treated. The outfit needed to perform this test is compact, and the time necessary to complete the test should not take more than four minutes."[1]

Dosage.—It is common practice to base the estimation of dosage upon the biological effects on the skin. For convenience, four degrees of erythema are designated. In a first degree reaction the skin shows a slight pinkish hyperemia which is not followed by visible exfoliation, and causes no subjective symptoms. A second degree erythema is accompanied by symptoms of mild sunburn with plainly visible reddening of the skin. This is followed by moderate exfoliation. A third degree erythema gives more intense scarlet reddening, the epidermis peels off in large strips, and there are symptoms of severe sunburn. A fourth degree erythema produces blistering.

The sensitiveness of each patient to the action of the rays governs the dosage employed. Individual toleration to ultraviolet light is variable. In general, blondes are far more susceptible than brunettes. The author has observed headaches, nervousness, stimulation, and general distress as the result of one-half minute exposures in a patient afflicted with tuberculous peritonitis and eczema. Under treatment at the same time was a young woman, decidedly brunette, who had been exploring the wilderness of the

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[1] Lane, C. G., and Rockwood, E. M.: Ultraviolet Light, Arch. Dermat. and Syph., 19: 461–462, March, 1929.

Amazon and living with the Indians in the open for one year. Exposures of twenty minutes with the same lamp at any equal distance produced scarcely any reaction in this individual.

For light baths the method is similar for all types of lamps, commonly beginning with small doses that just produce a slight reddening. It is better to keep the dose under this margin than to exceed it. There follows a continual slow increase throughout weeks and months as the patient becomes more tolerant. In the beginning the lamp is placed at about a distance of 30 inches, both the anterior and posterior portions of the body being irradiated in four exposures. At the second and subsequent treatments, the time may be increased and the distance very gradually decreased, depending upon the tolerance of the skin. Treatments should be administered daily or at least every second day for the first three or four weeks, and continued thereafter regularly with decreasing frequency.

In all cases the patient's tolerance should regulate the increase of dosage. Nervousness, apprehension, irritability, insomnia, or tachycardia are evidences of overexposure. The treatments should induce comfort and a drowsy feeling. A hyperemia generally appears six to twelve hours after treatment. It is desirable to produce a gradual deep tanning of the entire body without vesiculation or undue peeling. More than a first degree erythema should not be produced in general body irradiation.

The length of the interval between the exposure and the appearance of the reaction varies inversely with the wavelength and directly with the frequency of the treatments. Second degree erythemas may sometimes be applied daily, although most skins tolerate these exposures better if allowed a two-day interval between treatments. Third degree erythemas require three to seven days to heal, and fourth degree reactions usually do not involute for one or two weeks.

As a rough illustration of working dosage the following table is of practical value:

Carbon Arc Lamp

First	degree	erythema	at 30″	distance,	7 min.
Second	“	“	“ 30″	“	10 “
Third	“	“	“ 30″	“	14 “
Fourth	“	“	“ 30″	“	20 “

Mercury Arc Lamp (Air-cooled)

First	degree	erythema	at 10″	distance,	½ min.;	at 30″	distance,	3 min.
Second	“	“	“ 10″	“	1 “	“ 30″	“	8 “
Third	“	“	“ 10″	“	2 “	“ 30″	“	15 “
Fourth	“	“	“ 10″	“	5 “	“ 30″	“	30 “

Mercury Arc Lamp (Water-cooled)

First	degree	erythema	at	contact,	10 sec.
Second	“	“	“	“	25 “
Third	“	“	“	“	40 “
Fourth	“	“	“	“	1 min.

First	degree	erythema	at	2½″	distance,	1 min.
Second	“	“	“	“	“	2 “
Third	“	“	“	“	“	3 “
Fourth	“	“	“	“	“	4 “

First	degree	erythema	at	8″	distance,	2 min.
Second	“	“	“	“	“	4 “
Third	“	“	“	“	“	6 “
Fourth	“	“	“	“	“	10 “

For infants the dose should be about one third of the above, and for older children about two thirds.

The dosage of the radiation is influenced by: (1) The distance of the tube from the skin; (2) the inclination of the exposed surface to the direction of the rays; (3) the duration of the exposure; (4) the initial energy intensity (wattage) of the source; (5) the largest component of wavelengths, and (6) the individual sensitiveness of the skin.

Because the source of illumination is not a point in either type of mercury vapor lamp, and because of peculiarities in the absorption of ultraviolet light by various constituents in the air, the law of inverse square of distance, as stated, but roughly applies. It is more accurate for distance radiation with the air-cooled than with the water-cooled lamps. Lambert's cosine law applies to all types of lamps when they are used without applicators. The law states: "The intensity received by a surface varies as the cosine of the angle of incidence." Distance does not materially affect the longer ultraviolet wavelengths, so that this quality of radiation is unimpaired by its passage through air.

The operator must bear in mind that doses of ultraviolet radiation too weak to produce an erythema nevertheless may have a curative action. Such doses and those corresponding to a first degree erythema are tonic and mildly stimulating. They are usually administered in the form of general body radiation and cause an increase in the activity of the metabolic processes, described elsewhere. The dosage used therapeutically cannot be definitely fixed. The variations in the sources of light and in individual susceptibility are too great to permit a general standard.

Indications.—The prolific experimentation in the last few years, although highly valuable, has caused very little change in therapeutic applications of ultraviolet light in dermatology. It is advisable to exercise conservatism in the appraisal of quartz lamps, as their reputation has unfortunately suffered by exaggerated reports of their value. In comparison with the roentgen ray in the treatment of skin diseases, ultraviolet lamps must take an inferior position. The roentgen ray as used today in measured dosage has a much wider field of usefulness in dermatology than ultraviolet lamps, their place being nevertheless valuable although restricted. Two points in favor of ultraviolet lamps are their simplicity of operation and their freedom from danger.

An extensive report of the use of ultraviolet radiation in diverse cutaneous diseases by Jaramillo contains pertinent conclusions. Rarely are the ultraviolet rays alone capable of producing a complete cure. They are valuable largely as adjuncts to other forms of therapy, chiefly because of their eutrophic action upon the general condition. In local use they can often be readily displaced by chemicals, sunlight, *x*-rays, or radium, and equally good, if not better, results obtained.

It is well for the reader to have these observations in mind during the perusal of the following pages, so that he may not gain the impression that ultraviolet light is a cure for all diseases.

The clinical uses of ultraviolet light in the realm of dermatology may be briefly indicated:

1. *Staphylococcus and Streptococcus Infections of the Skin.*—In *acne vulgaris* ultraviolet light is particularly useful for the control of acutely inflammatory types of the disease (in which the application of *x*-rays is sometimes

irritating). First or second degree erythema exposures to ultraviolet light given twice weekly lead to a rapid absorption of the acute, and often the pustular lesions. As the benefits from this treatment are temporary, the ultraviolet light applications are stopped and x-rays are employed after the acute stages have subsided. Actinic therapy is useless in the treatment of comedones. It is, therefore, principally indicated in types of this disease in which comedones form a very minor part of the clinical picture. Ultraviolet therapy is indicated in *acne cachecticorum*, in which the technic should include generalized tonic exposures in addition to applications to the affected areas. The results from such therapy in this disease, although not as rapid and spectacular as those from roentgen radiation, are ultimately often more satisfactory, because the tendency to excessive scarring is retarded by the ultraviolet therapy.

Involution of the fluctuating boggy swellings of *cystic acne* follows persistent treatment with ultraviolet light. Compression is advisable. Third degree reactions should be given every week or ten days. Sometimes one treatment eradicates the lesion; while in other cases six to eight treatments are required. In recalcitrant cases it is recommended, before each exposure, to incise and drain the cysts, especially the larger ones. Sometimes similar and more lasting results can be obtained by x-rays. In the *keloid* type of acne, sometimes called acne keloid, ultraviolet light occasionally gives unexpected results with complete involution, but the cure is more certainly accomplished by roentgen radiation.

In the *pitted scars* that are present after the resolution of the severe types of acne, blistering exposures of ultraviolet radiation cause an increase in local nutrition and an epidermal exfoliation, which leads to marked improvement or complete eradication of the scars, in the place of which normal tissue is substituted. Sometimes spectacular results follow one exposure, but at other times eight to ten exposures are required, and occasional cases of long standing may not be responsive even to this number.

Although improvement in acne vulgaris is invariably attained by ultraviolet therapy, as stated, it is usually temporary, and the recurrences which become manifest generally require roentgen therapy to complete the cure. A definite portion of the cases of acne are incurable even by the use of x-rays. Recurrences in such cases in which contraindications to further x-ray therapy exist are handled temporarily in a most satisfactory way by ultraviolet exposures, both general and local.

In the papular and pustular types of *rosacea* ultraviolet light often hastens the involution of the lesions. The results in this disease are superior to those obtained by roentgen therapy. The treatment must always be combined with other measures, both internal and external. First and second degree reactions are produced by distance radiation from either the air-cooled or water-cooled lamp.

In *furunculosis* ultraviolet light is used in tonic generalized exposures to improve the patient's resistance and is applied to the individual lesions to produce second degree reactions, which hasten involution and absorption. If applied in the early stages the development of the furuncle may be completely aborted. Iacchia[1] has stated that the radiation of autogenous *vaccines* with ultraviolet light prior to their injection increases their potency. *Carbuncles* should be treated by both generalized and local treatments as described above. Ultraviolet is particularly useful in the attempt to abort early small carbuncles and is also employed to stimulate rapid healing after incision and drainage have been performed.

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[1] Iacchia: Loc. cit.

There are numerous reports in the literature upon the use of ultraviolet light in *erysipelas.* Even if the reports can be taken at their best, the results are not comparable to those obtained by other methods of treatment.

In *impetigo* the results obtained by the author with ultraviolet treatment have been disappointing. In spite of the bactericidal power of the far ultraviolet rays and the lack of such action from roentgen rays, the latter have produced superior results in the local treatment of impetigo. These observations also apply to impetigo of Bockhart and other forms of folliculitis.

Generalized ultraviolet radiation in tonic doses is, however, a valuable means of increasing the patient's resistance in both impetigo and *pyodermia.* In infants and children affected by these diseases, tonic exposures should be given daily. I have often cured infants afflicted with apparently hopeless furunculosis and pemphigus neonatorum by this simple form of therapy. In *echthyma* similar treatment, together with the production of second degree reactions upon the affected area, is the method of choice. Russell calls attention to ultraviolet therapy in *ischiorectal abscess.*

Sycosis vulgaris has been extensively treated with ultraviolet light. Results in my hands have not been as favorable as those reported by many. In *paronychia* and *granuloma pyogenicum* I have had a similar experience.

2. *Cutaneous Tuberculosis and the Tuberculides.*—In *lupus vulgaris* the achievements of ultraviolet therapy are of outstanding significance. Reyn has proved by statistics that general carbon light baths in addition to the local treatment increase the percentage of cures by about 25 per cent. Permanent cures by this technic are estimated between 70 and 90 per cent. Sequeira has found ultraviolet therapy especially valuable in the dry type of lupus situated on the face. Local treatments should produce a pronounced erythema and vesiculation. It is believed by some that patients whose skin pigments best make the most rapid and complete recoveries. Apparently, it is the inflammatory reaction rather than the direct bactericidal action of the ultraviolet rays which effects the improvement.

Because of the rarity of lupus vulgaris in this country, our experience has been small as compared with that of foreign dermatologists. The foreign lupus clinics are largely supplied with carbon arc light.

Blistering exposures of ultraviolet light, usually caused by compression treatments, have been extensively used in *lupus erythematosus.* Although the literature abounds with praise for this method, I have yet to see a patient cured by it. It is common to see lesions completely disappear after such treatment, but they invariably recur, and at each recurrence there is some spreading at the edges so that the ultimate result is worse than before treatment was instituted. It seems most indicated when the scalp is involved. I have observed several instances of the outbreak of lupus erythematosus upon the chest, back, and sides of the neck following a second degree reaction of ultraviolet light applied in attempts to increase the patient's resistance or reduce cervical adenopathy in patients affected by lupus erythematosus of the face. Similar spreading frequently follows roentgen therapy of this disease.

In *tuberculous adenitis, acnitis, folliclis, erythema induratum, papulonecrotic tuberculide, scrofuloderma,* and *tuberculous fistulae* and *sinuses* generalized ultraviolet treatments together with the production of second degree reactions over the sites affected invariably produce improvement. In *acne* *varioliformis* local applications cause a rapid disappearance of the lesions. In *tuberculosis verrucosa cutis* the lesions should first be removed by desiccation and curettage, after which ultraviolet light is applied locally and generally. In my limited experience there is no better form of treatment.

3. *Parasitic Skin Diseases.*—Lawrence has obtained striking results in the treatment of *blastomycosis* with ultraviolet radiation. In one patient the lesions were localized; in another the condition was generalized. Diagnosis was proved microscopically. He relates another case of systemic blastomycosis cured by a year's residence at a Florida bathing beach. Carter has found ultraviolet therapy useful in *actinomycosis.* In *tinea versicolor* Scholtz has obtained excellent results by full erythema doses, and my experience confirms his report.

Ultraviolet light is also occasionally useful in the treatment of ringworm infection, especially the intertriginous and vesicular types of *dermatophytosis.* In rare instances it produces improvement in cases which have failed to respond to *x*-ray therapy, although usually the latter is unquestionably a preferable method.

In the literature a few favorable reports are made concerning the use of ultraviolet radiation in *tinea barbae* and for the itching which occurs in *scabies,* but better results may be accomplished by other means. My personal experience in parasitic sycosis has shown ultraviolet far inferior to roentgen therapy, although the former does cause slight temporary improvement by the absorption of some of the infiltration.

Ringworm and favus of the scalp do not respond to ultraviolet light. Cases of kerion and other forms of *tinea profunda* may be aided slightly by a combination of radiation with local remedies.

Ultraviolet therapy plays a minor rôle in the treatment of parasitic skin diseases and should always be combined with other measures.

4. *Inflammatory Dermatoses of Unknown Origin.*—In most of the diseases in this group ultraviolet light has a proper place as an adjunct to other forms of therapy. Used alone it causes complete cures only in the mildest cases, which would respond readily to almost any treatment.

In infantile *eczema* generalized exposures for tonic purposes exert pronounced benefit. In adults affected by eczema ultraviolet therapy is applied for similar purposes and occasionally attains equally notable results, especially in eruptions of internal origin produced by derangements of the calcium metabolism. Gans and Schlossman have shown that ultraviolet therapy raises the calcium content of the skin in conjunction with increasing its permeability. The actinic energy has a mildly antipruritic action and stimulates absorption of exudates and the process of healing. In the treatment of eczema the dosage applied to local areas should produce a first or second degree reaction.

In *psoriasis* of the scalp where the use of *x*-rays of ordinary voltage is limited, ultraviolet light acts as a poor substitute, being inferior to radium or supersoft *x*-rays. Daily exposures of it are given with a dose which produces first or second degree reactions. In acute more or less generalized guttate or nummular outbreaks ultraviolet light is beneficial until the acuteness of the disease has somewhat subsided, at which time *x*-ray treatment may be instituted. In the more chronic or inveterate lesions, an occasional case responds to ultraviolet baths given daily. Zeisler states: "The pigmentation resulting from exposure to sunlight or ultraviolet light undoubtedly modifies the course of the disease, and, although not curative, may delay recurrences." Goeckerman believes that the use of coal tar upon the lesions prior to the ultraviolet treatment sensitizes them to the effects of the light and increases the benefits. In my experience the responsive cases usually belong to the "dermatitis seborrhoeica psoriasiformis" group in which the scales are more greasy than micaceous, and unthickened lesions tend to have a centripetal distribution. This type involutes readily from roentgen ray, ointments, or other types of treatment, so that the ultraviolet radiation accomplishes nothing unusual in the treatment of psoriasis.

In isolated instances the guttate and en plaques disseminée types of *parapsoriasis* have been improved by ultraviolet radiation. Wise, Schamberg, Chipman, Zeisler, myself, and many others have observed these results. The lesions usually recur although the free interval may last a year or more.

First or second degree reactions with ultraviolet light produce an epidermal exfoliation, which removes the lesions of *pityriasis rosea* by desquamation. The treatment is a rather drastic attempt to eradicate the eruption and most patients prefer the disease rather than the cure by this method. The disease itself is harmless, self-limited, and not uncomfortable, whereas the erythema and exfoliation produced by the treatment cause the discomforts of a severe general sunburn.

Slight improvement is occasioned by ultraviolet treatment in the acute generalized types of *lichen planus* and in *dermatitis herpetiformis*, but it is of minor importance in the therapy of these diseases. It is useless in pemphigus.

5. *Diseases of the Sebaceous Glands.*—Acne vulgaris and rosacea have been discussed in group one.

Both the dry and oily types of *seborrheic dermatitis* are improved by ultraviolet therapy. Suberythema exposures usually suffice for seborrhea sicca. In seborrhea oleosa it is advisable to produce second or third degree reactions, which cause desquamation and leave the skin dry, soft, pink, and of fine texture. Enlarged pores may be improved. These cosmetic advantages are sometimes offset by intense freckling.

Seborrheic dermatitis of the scalp is included in group six. Adenoma sebaceum is mentioned in group eight.

6. *Diseases of the Hair Follicles.*—The active hyperemia produced by intensive exposures of ultraviolet light seems to stimulate the growth of hair in most early cases of *alopecia areata.* The character of this disease makes it difficult to estimate the value of the radiation. In my opinion, the results of the ultraviolet therapy do not differ from those of other agents which produce hyperemia. In cases of long duration, especially of the universal type, ultraviolet light treatment is useless.

This radiation is used extensively in other types of alopecia. Exposures which will produce a first degree reaction are given to the top, back, and sides of the scalp. At least five or six weekly treatments are the minimum to produce results. The growth derived in *seborrheic alopecia* from such stimulation is nearly always a short fine downy fuzz which does not develop into vigorous hair, and which falls out soon after the stimulating treatments are stopped. In *pityriasis sicca* the dandruff is rapidly dissipated by two or three first degree reactions. In *pityriasis oleosa* the oiliness is sometimes improved, possibly due to the drying effect of the heat caused by longer wavelengths. In cases of *alopecia symptomatica* following febrile sickness, shock, or pregnancy the tonic effect of generalized and local ultraviolet treatment seems to favor the restoration of a good growth of scalp hair. In *alopecia cicatrisata* and *folliculitis decalvans*, erythema exposures are beneficial as adjuncts to treatment by other methods. I have treated one case of *pseudopelade* of Brocq without improvement. In all types of alopecia ultraviolet treatment at times seems to check the falling of the hair, and at other times to hasten the regrowth of new hair. Danforth has shown that its action in alopecia is not specific and that whatever effect it has is due to increased nervous and vascular tone.

7. *Diseases Related to the Cutaneous Nerves.*—Both ultraviolet rays and roentgen rays have a sedative action upon itching. The action of ultraviolet rays is slighter, less constant, and less lasting than that of roentgen rays. The relief is symptomatic and temporary, and can be made permanent only by discovery and treatment of the cause.

In *pruritus cutaneus*, either generalized or localized, ultraviolet exposures occasionally contribute relief. Suberythema dosage is advisable, as stronger doses often cause other discomforts without relieving the pruritus. Small and extensive areas of lichenification are slightly benefited by the antipruritic and stimulating action of this form of treatment. The improvement is transient and meagre compared to that afforded by roentgen therapy.

Second and third degree reactions over the posterior nerve roots and over the areas of their distribution have been been commended by Plank and others at the onset of *herpes zoster*. Such treatment is often said to arrest the development of cutaneous manifestations, and relieve the accompanying neuralgic pains. My own faith in ultraviolet therapy has not been sufficient to sanction such extensive reactions in a patient already uncomfortable.

8. *Congenital Anomalies.*—In *nevus flammeus* ultraviolet treatment promises the patient better results than are obtainable by any other method. All cases show some improvement, and even marked improvement after one or two treatments is not unusual. Generally, a certain point of improvement is attained beyond which no further benefit is derived from the treatments. Cases which respond best are of the superficial types, which readily fade on pressure. Those which are pink or scarlet respond better than those of purple or bluish tints. Blistering exposures must be persistently applied over many months. Some workers prefer administration of each dose before the erythema of the preceding one has disappeared, basing this practice upon an intention to keep the vessels in a continuous state of inflammation, so that they do not have time to recover from one dose before another dose is given. Other workers give the treatments at intervals of three weeks with the expectation that each reaction will subside before the following treatment is scheduled, so that the lessened congestion will afford greater penetration. I have observed no differences in the results of these methods, or from even longer intervals between treatments.

Although compression treatment with the water-cooled mercury arc lamp has been the classical method, distance radiation with the air-cooled type without compression has given me equally good results. This is contrary to theory, but other clinical results in ultraviolet therapy are in the same category. One advantage of the air-cooled lamp for such treatments is the avoidance of the mottled appearance produced by the small lenses of the water-cooled lamp upon extensive surface areas. The reaction from the air-cooled lamp is of the same intensity throughout the extent of the nevus and a homogeneous fading results in the entire lesion.

The advantage of ultraviolet therapy for "port-wine mark" lies in the absence of scarring or other sequelae, which usually follow other potent methods of eradication.

Adenoma sebaceum is successfully treated by third degree reactions of ultraviolet light. The papular type responds better than the telangiectatic type, but both are improved and sometimes cured by repeated treatments similar to those applied to nevus flammeus. A splendid result in the Pringle type was shown by Abramowitz at a meeting of the Brooklyn Dermatological Society at which I was present. I personally prefer desiccation for adenoma sebaceum because it achieves a rapid complete cure without scarring.

In *xerosis* and *ichthyosis* generalized exposures with mild reactions stimulate the glandular activity and alleviate the scaling and dryness. With the development of pigmentation the skin loses its harshness and becomes normal in appearance. The benefit lasts for a year or two but is not permanent. Improvement in metabolism due to the radiation may also have a favorable influence upon the disease.

9. *Benign New Growths.*—Small young *keloids* may be successfully treated by doses of ultraviolet light sufficient to produce third degree reactions. *Syringocystoma* and *xanthoma tuberosum multiplex* are also occasionally improved by similar therapy.

10. *Roentgen and Radium Dermatitis.*—The use of ultraviolet light in this connection is discussed in Chapter XI. The specific indications for it are few. It may stimulate the healing of chronic ulcerative radiodermatitis if small doses (suberythema) are used. The telangiectasias produced by radiotherapy may be benefited by third degree ultraviolet reactions. Russell, Hazen, and Lane have had success with this method. Personally I prefer electrolysis.

Ultraviolet energy should not be applied to acute *x*-ray or radium burns, as all these forms of radiation are complementary.

11. *Miscellaneous Diseases.*—The literature contains a long list of miscellaneous diseases treated more or less successfully with ultraviolet radiation. Rapid healing and relief from pain are recorded in a number of accidental injuries including *bruises, burns, frostbite, chilblain* and *hematoma.* I have had little personal experience with its use in connection with these conditions.

Disturbances of pigmentation, including *chloasma, leukoderma* and *vitiligo,* have been favorably mentioned for ultraviolet therapy, but in my hands this method of treatment has been ineffectual.

Likewise, my experience with the ultraviolet therapy for urticaria has been disappointing. It has not been of benefit in acute or chronic urticaria, or in *urticaria pigmentosa.* The same may be said of the results in *erythema multiforme* and *herpes recurrens.*

Keratosis pilaris and hypertrophic scars may be gradually benefited by erythema exposures. In the end-stages of *dermatitis venenata* the itching may be alleviated by suberythema doses; it should never be used in the early stages. Its value in this disease is almost negligible. Wise and Fox, using the compression method, have found the lesions of angioma serpiginosum benefited by third degree reactions. With ultraviolet therapy they also brought about improvement in the lesions in one case of the juvenile type of *acanthosis nigricans.*

In addition to the indolent lesions of roentgen and radium dermatitis, granulating wounds, and various *ulcerations* of circulatory trophic or bacterial origin heal with surprising rapidity when treated with ultraviolet light. *Varicose ulcers* of the leg and trophic ulcers dependent upon poor peripheral circulation are stimulated by the active hyperemia produced by erythema exposures. The infection which is present in many of these lesions at the beginning of treatment soon disappears under the ultraviolet therapy. The resulting scar is pliable and firm, and the thickened eczematous skin around the lesion becomes normal. The use of ultraviolet radiation in erythema doses daily for three or four weeks will enhance the chances of success in lesions where skin grafting is undertaken. McArthur and Pacini call attention to the injurious effects of excessive doses upon the immature cells of the proliferating epithelium.

In *traumatic ulcers* and those caused by *chancroid* and *tuberculosis*, ultraviolet therapy has valuable effects. It is also useful in *perforating ulcer* of the foot and in bedsores. Grove and Vines believe that toxic ulcerations begin to heal only when the "ionic calcium content" of the blood becomes normal. If, according to their observations, the ulcerations are slow to respond, generalized irradiation is given in addition to biological treatment to increase the calcium value. Ultraviolet therapy should usually be combined with other therapeutic measures in the treatment of the various classes of ulcers which have been mentioned.

In the treatment of *syphilis*, Russell, Rollier, and others have advantageously combined heliotherapy with antispecific medicaments. Generalized irradiation improves the defensive mechanism of the body, and local ultraviolet therapy to secondary or tertiary lesions hastens their disappearance.

In *cancer* ultraviolet energy has no direct use, but may be advantageously employed for the tonic effect derived from generalized exposures. Improvement of the metabolic functions under such therapy has been adequately confirmed by numerous experimental and clinical data. Also, Lounsberry and others have hastened the healing of operated cases of cancer by stimulation of the granulations by local application of this agent. In the absence of more information it is doubtful whether such a practice is justifiable. The influence of ultraviolet radiation on the takes and growth of transplantable carcinomas in rats and mice has been studied by Sugiura and Benedict. To quote, "*In vitro* experiments indicate that the proliferating capacity of Flexner-Jobling rat carcinoma was stopped by the radiation in comparatively short exposures. This destructive action appears to be due to the selective absorption of the radiation by the cancer cells.

"The results of irradiation of a malignant mass at a depth in the animal body by ultraviolet radiation applied externally may be summarized as follows: (*a*) The development of small tumors is checked by severe doses; (*b*) there is an increased rate of growth of malignant tumors after inadequate irradiation of small tumors, and (*c*) large tumors are seldom beneficially affected by the radiation."

Moppett has experimented with ultraviolet light upon normal and malignant tissues grown *in vitro,* and found that the malignant tissues have greater resistance than normal tissues to this form of energy when grown *in vitro* by his method.

There are certain **contraindications** to ultraviolet treatment. It should not be applied to highly febrile patients or those who suffer from grave arterial or cardiorenal disease. It is contraindicated in very acute eczema.

Treatment should be discontinued if the patient becomes excessively nervous after the first two or three applications, or in cases of psoriasis if it seems to cause irritation and spreading of the lesions.

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CHAPTER X

SURGICAL DIATHERMY

Surgical diathermy is a method of destruction depending in major part upon the localized production of heat generated by the resistance of tissue to the passage of a high frequency electrical current, which produces a violent agitation of molecules. Medical diathermy is characterized by the stimulating action of heat so produced, whereas surgical diathermy is distinguished by the destructive action of such heat.

In accordance with the type and strength of the current, and the method of application, a variety of tissue effects are manifested. *Desiccation,* or fulguration, is destructive by flashing. The heat effect is sufficient to produce dehydration of the tissue. It occurs slowly enough to permit the tissue fluids to evaporate and causes a dry destruction of superficial cells. Because of the fineness and accuracy of this method it has superseded many older, less accurate destructive measures, especially the caustic acids or alkalis, and carbon dioxide snow. *Coagulation* is a more penetrative, intense, and rapid process, and the tissue fluids no longer being able to evaporate as rapidly as they are exuded, are notably in evidence. The tissues become devitalized to an amorphous necrotic mass. *Carbonization* (charring) is the reduction of the tissue into a residue of carbon. *Searing* is a general term applied to the edges of tissues treated with cutting currents, and comprehends any of the preceding degrees of destruction.

The microscopical changes have been described by Ward. Desiccation shrinks the cells into elongated shapes containing shriveled nuclei, which stain more deeply. In coagulated tissues all cellular structure is destroyed and the tissue proteins form a mass of homogeneous granular débris. The cutting current causes less extensive histologic changes. At the point of contact there is a fine line of molecular disintegration appearing as minute particles of carbon, beyond which the tissue is coagulated to a distance of about 1/10 mm.

Current and Apparatus.—Desiccation is produced by a current derived from an Oudin resonator. The Oudin current is of relatively low amperage and high voltage, in which the return flow of current from the patient to the machine is probably through electromagnetic waves, so that the terms "monoterminal" and "uniterminal" which have been applied to it, are in a sense misleading. Desiccation is accomplished by the application of this type of current through a metallic sewing needle touching or inserted into the tissues. The high voltage, low amperage, and the number and character of the oscillations produce a very superficial destruction. Coagulation is generated by a rapidly oscillating biterminal low voltage current of high amperage of sustained and damped oscillations especially produced for the purpose. One terminal is connected to an indifferent electrode and the other is attached to the active electrode which is held against or inserted into the diseased tissue. Desiccation does not necessarily mean treatment with a uniterminal current, and coagulation with a biterminal, because heavy uniterminal currents may produce some coagulation and mild biterminal currents may cause only desiccation.

Cutting is produced by a continuous undamped oscillating current. Undamped oscillations are of equal intensity and amplitude. In some machines used for cutting, continuous undamped oscillations are obtained by the introduction of a radio bulb. Other machines approximate continuous undamped oscillations by a proper balance of the inductance coils, spark gap, and the capacity of the condenser.

In the *radio bulb apparatus* for producing undamped oscillations there are a transformer for adjusting the voltage of the incoming current, a spark gap, two oscillation vacuum tubes arranged in parallel, and condensers and inductances connected with these tubes. The latter resemble the Coolidge x-ray tubes but have three electrodes. A heated filament generates the electrons which act as conductors of current from the filament to the second electrode or plate. The third electrode is the grid and this is situated between the filament and the plate where it controls the current flowing to the plate. The principal reaction of the oscillation tube is amplication of the current applied to the grid. The small current applied to the grid is reproduced in the circuit containing the filament and the plate. From this it passes through the primary of the high frequency transformer, which has no iron core. The magnetic flux is developed in the inductance, acts upon the variocoupler, which is located at the end of the primary inductance and produces oscillations in accordance with a natural frequency corresponding to the size of the condenser and the inductance of the variocoupler. There is thus imparted to the grid a small oscillating current, which gives an oscillating voltage to the grid, and this voltage stirs the heavier discharge between the filament and the plate. The frequency of the oscillating circuit is therefore controlled to a large extent by the frequency of the grid circuit, and the latter functions as a starting mechanism for the oscillations in the circuit between the filament and the plate, which, however, has its own natural frequency. Consequently, in order to obtain the maximum output, the frequencies of this current and of the grid current must oscillate at exactly the same rate. It is essential that the two oscillating circuits be synchronous. A small Neon lamp is used to indicate that the two circuits function harmoniously. By manipulating the variocoupler with this lamp in circuit, a point is found where it glows brightest, and this indicates resonance between the two circuits. When so adjusted, the apparatus is ready for use. To avoid danger of shock the patient's circuit is indirectly connected to the main oscillating circuit through a magnetic coupling.

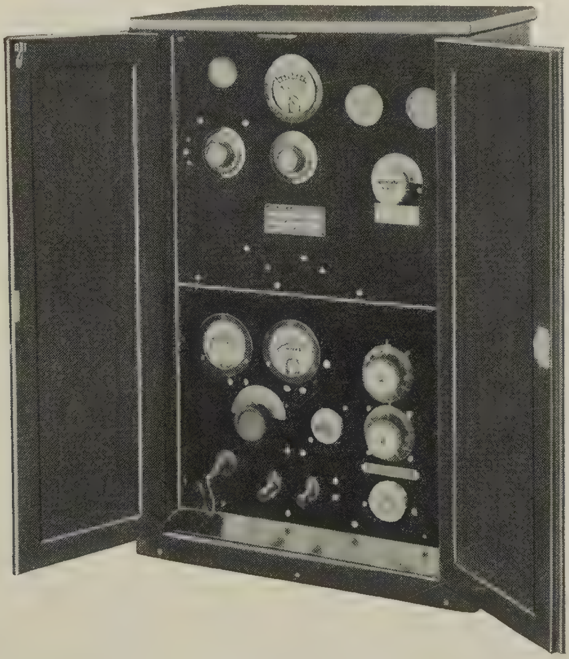

Fig. 130.—Radio bulb apparatus for surgical diathermy.

In the radio tube type of machine, the undamped oscillations, while coagulating to a slight degree, have the distinct property of cutting through tissue. In the event that large blood vessels are encountered during the operation, the undamped oscillations of the coagulating current are used to stop the bleeding.

In the *cutting machines built without radio bulbs*, the line current is passed through a step-up transformer, in the secondary circuit of which are a resonator coil, a spark gap, and condensers. As the condenser is charged and discharged, magnetic lines of force are built up and die out along this circuit and by inductance produce, in a distinct circuit, oscillations of high frequency, which are sustained by a control device so that they are practically undamped. Safety is assured by the fact that this circuit, which leads to the patient, is connected with no other part of the apparatus except by inductance.

For cutting purposes 750,000 or more undamped oscillations per second are used. In these machines coagulation may be obtained from the cutting circuit without changing over to another unit, that is, if a hemorrhage is encountered in the process of cutting, the current is applied to the point of bleeding. If the amount of current then in use does not immediately stop the bleeding, the coagulating effect is increased by regulation of the thermocoupler, which controls the heat of the cutting current. Thus, the coagulation is produced through the same circuit used for cutting. In this type of machine the spark gap is used to control the *quality* of the cut; that is, if the spark gap is open wide, a rough spark and a heavily coagulated cut are obtained. If the points of the spark gap are set very close together a minimum amount of coagulation occurs at the cut. The thermocoupler controls the amount of current flowing through the patient or active circuit, thus regulating the speed of cutting.

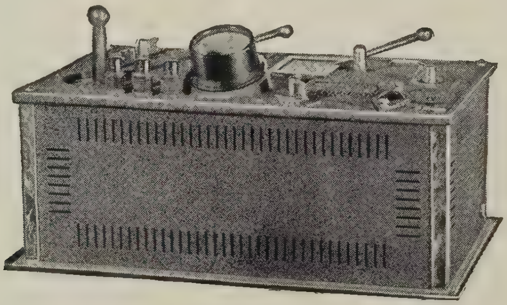

Fig. 131.—Surgical diathermy machine constructed without the use of radio bulbs.

With both types of instruments, the cut is clean without sawing, and is sterile. The small capillaries on the cut edges are sealed in the process of cutting. It is essential to use the particular frequency which produces a clean and neat cut without carbonization. Cuts thus made may be sutured and will heal by primary union.

The physical cause of *cutting effects* is not known. Inasmuch as in certain types of apparatus the rate of cutting is little affected by the accompanying heat or coagulation, it would appear that the cutting is probably not a pure heat reaction, although heat may have something to do with it. The ordinary diathermic apparatus, not designed for cutting, will coagulate and produce all the heat effects of the surgical diathermy, but will not cut. It is very probable that the heat is not so great with a cold spark, because frequently searing may be so slight that oozing is present immediately after the cut is made. Apparently, voltage has little to do with cutting. The cutting is caused by a flow of continuous undamped oscillations at a rate of 800,000 and over per second.

Associated Changes.—The application of any of these currents causes other changes than those grossly visible in the tissues. These are of a physical and chemical nature, and their sum total is sufficient to produce sterilization of both bacteria and malignant cells. The applied current produces heat, steam, nitrous fumes, ozone and ionization, and liberates electrons analogous to the beta rays, and electromagnetic vibrations similar to soft *x*-rays or ultraviolet rays, though the latter are of trivial importance, being incomparable with those used in *x*-ray or radium therapy. Heat, nitrous fumes, and ozone are definitely sterilizing agents. Little is known of ionization, though it is believed it may also have a sterilizing influence.

Operative Technic.—In accordance with the requirements of each individual case, there are many variations of technic, which must be learned from practical experience for they cannot very well be described. Care should be exercised in the sterilization of needles, syringe, and in the preparation of any solution to be injected. It is imperative in the application of endothermy that no alcohol, ether, or other inflammable liquid be used on or near the area to be treated, as the spark will set fire to any such liquid. Thorough scrubbing with tincture of green soap and sterile water should be followed by painting with tincture of iodine. When this or alcohol, alcoholic solution of picric acid, or benzine is used on the area before treatment, it should be thoroughly dried before the spark is applied.

Cosmetic desiccation of superficial lesions usually requires no anesthesia. For the epilation of hypertrichosis, no anesthesia is used. For warts, novocaine is administered by injection. For lesions of the mucous membranes, sufficient anesthesia is given by absorption of surface application of cocaine or holocaine. Instillation of a few drops of 1 per cent solution of cocaine should be made before operations on or near the eye. Immediately following the completion of the operation the eye should be bathed with a solution of boracic acid.

It is advisable to test the size and character of the spark upon a metal instrument before using it for treatment. The spark for most lesions should be clean, cold, regular, and should not feather.

The desiccating current may be applied to the lesion by a sewing needle directly connected with the generator by a cable. Another method is to have the patient grasp an indifferent electrode so connected, while the operator draws the current from the lesion with a sewing needle. The operator's fingers are placed in contact with the patient, and by increasing or lessening the amount of this contact, the intensity of the spark drawn from the lesion by the sewing needle may be regulated.

Coagulation and cutting generally require that the patient be in the recumbent position and receive local or general anesthesia. For local anesthesia it is best to anesthetize an area the size of a split-pea by an ethyl chloride spray and to introduce the needle for novocaine into the spot so anesthetized. Wherever there is suspicion of malignancy, general anesthesia, with gas and oxygen, or ether is advocated, unless satisfactory desensitization can be obtained by injections of novocaine far beyond the affected areas without the introduction of the needle into the growth. Infiltration of cancerous tissue is inadvisable as such technic may cause a dissemination of metastases and tend to obscure the indurated outlines of the new growth. Many large destructions can be done under morphine combined with scopolamine and atropine, or hyoscine and cactine.

When ether is used it is safer to anesthetize with a cone in an adjoining room and then to roll the patient into the operating room, or if administered in the operating room, the windows should be open and the can of ether kept well away from the spark. The operator can control these dangers to a great extent by not allowing any sparking to occur. This is accomplished by placing the needle in the tissue before the current is turned on and by keeping it embedded during the entire time the current is on, only removing it after the current has been turned off. Nerve blocking by injections of novocaine into the sheath is frequently of value, and rectal or spinal anesthesia is occasionally useful.

The use of a bipolar current requires an indifferent electrode. This is conveniently attached by a cable to an aerial. Various forms of indifferent electrodes are used. The most satisfactory is a metal plate, measuring about 6 by 8 inches, with rounded corners. This is covered with two thicknesses of a towel soaked in hot saline solution. It is important that a strong solution of not less than 10 per cent should thoroughly saturate the towel, as weaker solutions offer resistance to the current and may induce scalding, especially if the patient is unconscious. A strong soap solution may be substituted for the saline. Bare metal tinfoil may be smeared with diajel, a water-soluble jelly which conducts electricity.

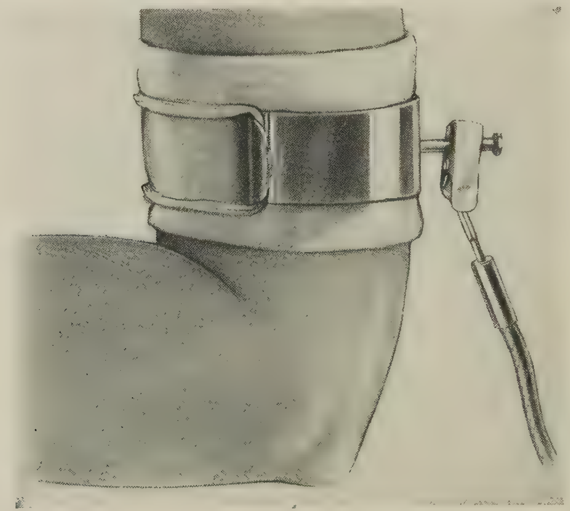

Fig. 132.—Indifferent electrode attached to the upper arm.

The flat electrode is placed upon the trunk and so bandaged in position that the moistened towel interposed between it and the skin makes contact with the body at all points. It may be bandaged over the chest or abdomen or placed under the back or hips, where the weight of the body holds it in place. Modifications of this form of electrode may be strapped on the upper arm or hand. In minor operations a tubular electrode may be held in the patient's hand. Much loss of time and annoyance are caused by patients dropping the tubular electrode at critical moments during operations; therefore firm fixation of the indifferent electrode to the patient is advisable. The electrodes must always be in position prior to the diathermy current being turned on, and must not be removed from contact until it is turned off. If these precautions are not taken, sparks between the body surface and the electrode will occur and are likely to burn adjoining parts. Moreover, contact by any one with the indifferent electrode or the exposed end of the active electrode or the skin of the patient may produce burns from the sparks.

The active electrode is screwed into the end of a holder connected by a flexible cable to the instrument. It is very small and may be of various shapes and sizes. For *coagulation* it may be the shape of a disk or ball, a knife blade, or a needle. When the lesions are superficial and small, a ball or a flat circular disk-shaped electrode is preferable to a needle. This placed in contact with the lesion, with the current turned on, causes destruction to a depth of 2 or 3 cm., depending on the time and the strength of the current. This method avoids any traumatism from the insertion of a needle. The length of the knife blade or needle to be used as the active electrode depends upon the thickness of the area under treatment. The point of the electrode is inserted into the lesion as deep as necessary to coagulate the entire mass thoroughly. Unless the electrode is promptly applied to the tissue, sparks from it will produce undesirable charring. Enough current should be used sufficiently long to blanch the entire mass and the marginal tissue to a dark gray. Care should be exercised in coagulating tissues close to bone or cartilage because if the periosteum or perichondrium is destroyed, healing is delayed. When indicated, however, the bony structure can be completely destroyed and removed.

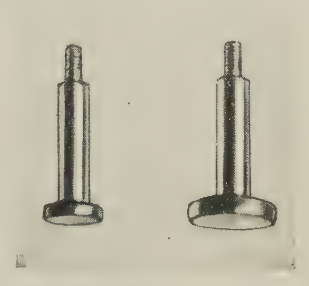

Fig. 133.—Disk electrodes.

The *cutting current* may be applied with a needle, a small knife blade, or various sized wire loops. The large wire loops are useful for the snaring of papillomatous growths, and the smaller ones make possible the making of biopsies without bleeding. The needle and small knife blade are specially adapted to the removal of the tongue or portions of that organ, or for the circumvallation of local malignant growths of the skin or mucous membrane. The technic for building a barrier of a coagulated, impermeable wall in the healthy tissues around and beneath malignant growths has been worked out by Clark, Ward, and Wyeth. Kelly and Ward have described it under the term "circumvallation." Before any application to the cancer is made directly, a

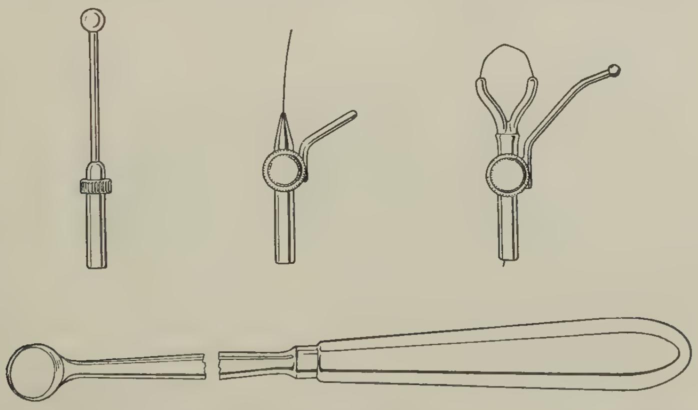

Fig. 133A.—Other electrodes, and below a ring for compression about a bleeding point.

wall of coagulation and necrosis is made surrounding the growth completely. The wall of coagulated tissue seals the blood and lymph channels about the lesion, as well as beneath it, thus isolating the growth from the surrounding structures and mechanically preventing the dissemination of viable cells and subsequent metastasis. After the lesion has been isolated, as outlined, tissue may be safely taken for microscopical examination since all blood and lymph drainage from the affected part has been cut off. The tumor itself is then coagulated, after which the destroyed mass is removed with a curette or a pair of forceps and small curved scissors, leaving a clean base. This base is again treated by searing over with the current to assure a further penetration by the heat and to destroy any malignant cells which may remain. Circumvallation also cuts off the sensory nerves so that local pain is alleviated. This method is particularly advantageous in the treatment of large, friable or ulcerated growths which it is almost impossible to extirpate by the scalpel or cautery without breaking into the mass of live tumor cells and disseminating them into the fresh wound, which may be fertile soil for their development.

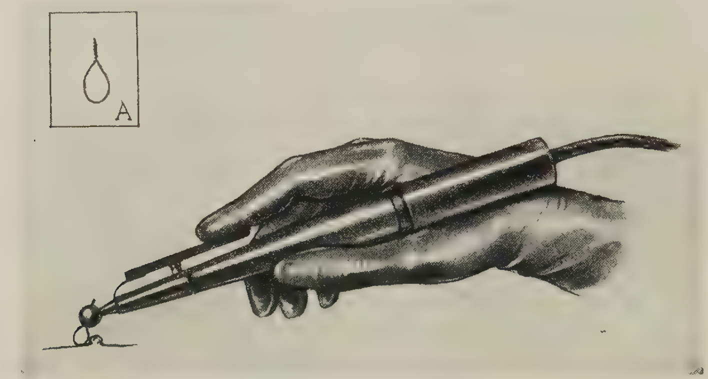

Fig. 134.—Illustration of the use of the wire loop and cutting current for the removal of small growths and of specimens for microscopical examination. A, Wire loop for cutting.

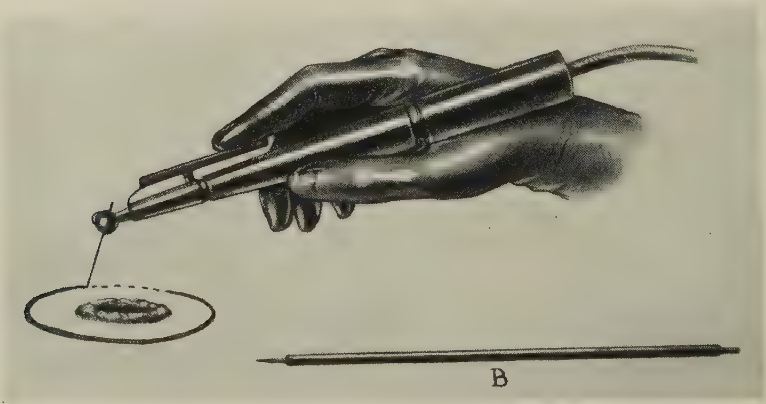

Fig 135.—Illustration of circumvallation. B, Long electrode used within the mouth.

When large blood vessels are encountered in the use of the cutting current, the electrode may be pushed directly into the bleeding vessel, or the vessel may be grasped with forceps and the electrode applied to the forceps at any place between the fingers and the bleeding. The current then courses down the forceps and extensively coagulates the bleeding vessel. When bleeding from the primary branches of large vessels is to be stopped, coagulation should be performed some distance from the larger trunk. If this precaution is not taken, a secondary hemorrhage may result from trauma, or the blood in the larger vessel may be coagulated by the current with some occlusion of its lumen. If the coagulation current is applied for a prolonged period to stop the bleeding or for other purposes, it produces considerable coagulation or carbonization of tissue, which must be removed or sloughed before the wound heals. Healing of such wounds is slow and frequently requires from six to eight weeks. The advantages of this method of hemostasis are numerous. Few ligatures are needed and much time is saved as it requires only one half to one third as long to lift the clamp and touch it with the active electrode as it does to tie off the vessel thoroughly and cut the ligature. There is less foreign material left in the wound by the coagulating method of hemostasis than by the ligating technic.

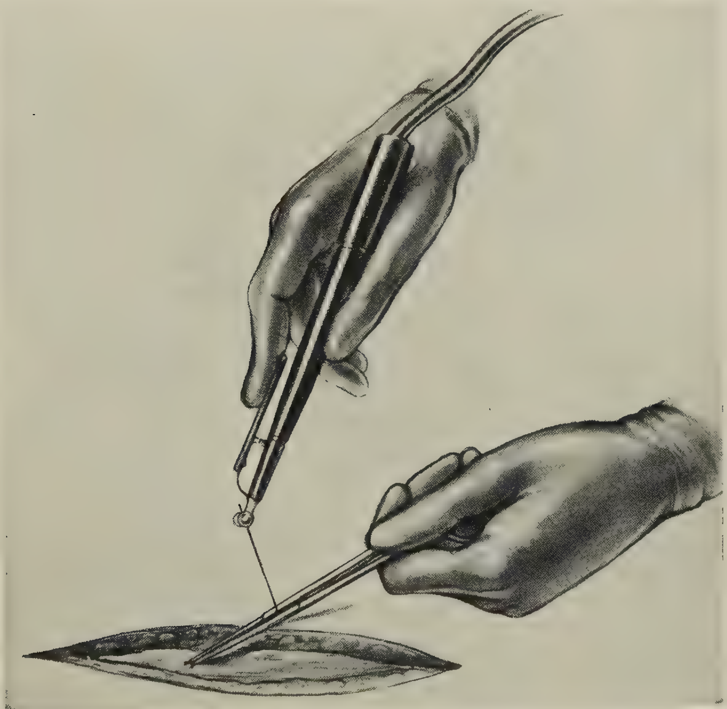

Fig. 136.—A bleeding vessel is clamped and the active electrode is touched to the hemostat, so that the current seals the vessel.

Secondary hemorrhages do not often occur, but have happened in isolated instances. When work is done in close proximity to large blood vessels like the carotid, a preliminary ligation is advisable. During the operation there is a constant circulation of blood, varying in rate of flow. In large vessels the flow is so forceful that the blood streams ahead of the field of current before coagulation occurs.

Pain and *charring* are proportionate to the heat of the spark. After-pain is minimal due to the blocking of the sensory nerve supply by the cutting current. Observance of the rules of asepsis and the use of isotonic solutions for injection decrease postoperative edema and the chances of infection, which sometimes is responsible for after-pain. Charring is invariably objectionable, as it forms a superficial carbon barrier over the treated area which restricts the deep action of the current and later delays healing.

As a measure of precaution it is best to remove the desiccated, coagulated, or charred areas because they favor secondary infection, except where the destruction is very superficial. In this case, for cosmetic purposes less scarring seems to result if the thin, desiccated layer is left in place, and kept soft by the application of creams. For removal of the destroyed areas, the curette, forceps, and scissors or the cutting current is used. The purpose of *dressings* is to keep the wound clean, relieve after-pain and swelling, and keep the edges soft. For immediate postoperative use wet dressings of boric acid solution or 10 per cent anesthesin in boric acid ointment or a thin layer of 1 per cent yellow oxide of mercury spread over the wound is desirable. Treated lesions should be cleansed morning and night, or oftener, with pieces of cotton soaked in boric acid solution. The frequency is indicated by the amount of discharge. When large sloughs are present sodium hypochlorite (1/10) or dichloramine-T in oil (except in buccal lesions) has special value. Hemorrhage may be caused by dry sticky dressings. Collodion dressings should never be employed, as the oozing which usually follows treatment makes them ineffective and favors secondary infection. The formation of hard crusts should be prevented as they are irritating and are likely to increase the incidence of secondary infection. After the sloughing and exudation have ceased, the wound is best treated by painting with 2 per cent solution of mercurochrome and covering with a dry dressing. In cases where large surfaces have been destroyed, ultraviolet radiation may be used to stimulate the healing.

Indications for Surgical Diathermy.—The accuracy of control of the desiccating current makes it extremely valuable in the treatment of small lesions where cosmetic results are not only desirable, but essential. The spark for this work should be very fine, clean, and not feathered.

The action of desiccation is so superficial that lesions in the subcutis or at greater depth are not suitable to its action. For these deeper lesions and for thick elevated growths the coagulating current is employed. The cutting current is used alone or in conjunction with the coagulating current for the removal of extensive areas.

All types of *pigmented nevi* must be regarded with great concern because of their potential malignancy. The majority of lesions are best treated by thorough wide removal with the scalpel or the endotherm knife. Many of the small light brown, flat or elevated, soft moles are treated for purely cosmetic purposes. This practice seems occasionally warranted in spite of the fact that the incidence of tumor formation from such lesions is disputed. In all events, it is exceedingly rare. By the use of a fine, clean spark which does not feather, selected cases of the flat types of pigmented nevi may be treated with practically no scarring. The technic requires repetition of desiccation at monthly intervals in a cribriform pattern over the lesion.

Hairy nevi may first be epilated by electrolysis before removal of the connective tissue or verrucous part of the lesion by desiccation. This technic only applies to small soft, light brown hairy moles, and even in such apparently innocuous lesions surgical excision or thorough removal by the endotherm knife is preferable when the location is such that scarring is of minor importance.

Angiomas may be treated by desiccation or coagulation. This method is inferior to radium therapy. More scarring usually results from desiccation or coagulation of angiomas than from radium or carbon dioxide snow treatment. It is best employed upon small cutaneous angiomas or angiomas of the buccal mucosa, tongue, or parts of the skin covered by clothing, where the occurrence of scarring is not important. Desiccation is used for the smaller lesions and coagulation for larger growths. Destruction must be thorough to avoid recurrences.

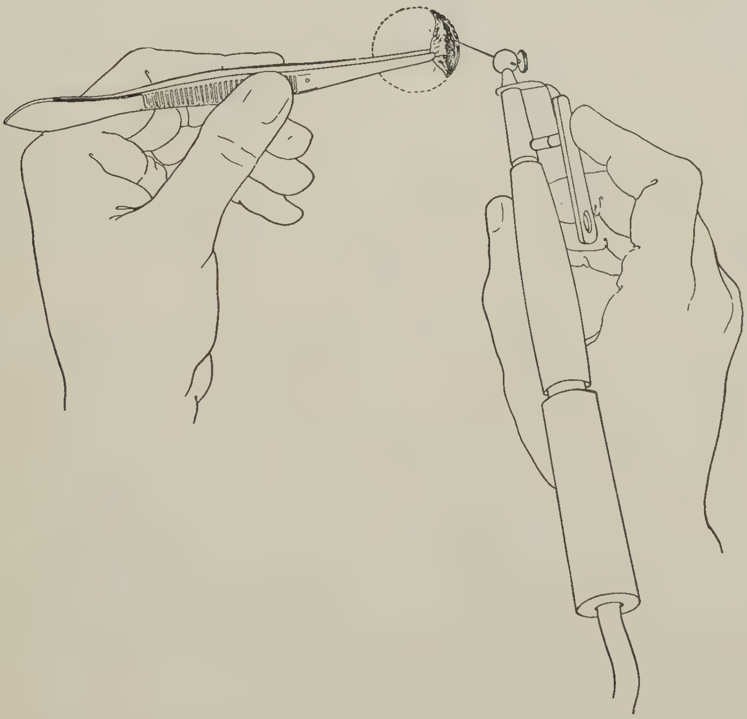

Fig. 137.—Illustration of method for removal of pigmented nevi by the cutting current. After a cut down to fat is made around the mole, it is removed by lateral dissection.

When large nevi are attacked, considerable current is required to coagulate the rapidly circulating blood. In cases of involvement of the whole thickness of the cheek or lip the finger should be placed on the overlying skin so that the current which is applied to the mucous surface may be turned off immediately when the skin feels hot. Otherwise sloughing of the skin and unnecessary scarring will occur. As tissue beyond the area of visible coagulation is destroyed, it is best to proceed cautiously and, in the case of some large nevi, to give additional treatments if necessary for complete destruction. Not, however, until after sloughing has taken place and observation made of the extent and effect of the first treatment, should any further exposure be applied. Sloughs usually separate in from ten to twenty-one days.

Stellate or spider nevi may be removed by using a mild current and inserting the needle electrode into the small central elevation from which radiate the dilated vessels, although the author usually prefers electrolysis because the destructive effect is slower and therefore easier to control. The papular and telangiectatic types of *adenoma sebaceum* respond without scarring.

In the superficial forms of *x*-ray *telangiectasia*, desiccation is a valuable agent as it eradicates the condition without scarring. A very small spark delivered from the point of a sewing needle is run along the line of the vessel, or the needle is inserted into the lumen of the vessel. This procedure is painful. In the treatment of extensive areas local anesthesia may be obtained by iontophoresis with novocaine. When the telangiectatic vessels are deeply situated, the results are less satisfactory. The author has used this method in other types of telangiectasis, especially rosacea.

In *xanthelasma* desiccation is a superior method of treatment. Its delicacy and accuracy in limiting the area of destruction are advantageous over the older methods, particularly the use of acids. Anesthesia by injections of novocaine is required. It is especially applicable to xanthelasma in blondes but not in brunettes, because in the latter the area desiccated occasionally becomes depigmented, resulting in a white or light-colored patch, almost as objectionable as the lesion itself.

Keratoses (senile, seborrheic, nevoid, arsenical, *x*-ray, radium) are easily removed in a similar manner. When the treatment has been thorough there are no recurrences.

Leukoplakia of the mouth, vagina, or glans penis is readily removed by desiccation. The field is sterilized by painting with tincture of iodine. Anesthesia is obtained by absorption of a 10 per cent cocaine solution applied to the surface. Then the current is applied and the dehydrated tissue is peeled off by a dull curette. The treated areas are kept clean by frequent irrigation with sodium hypochlorite solution (1/10), and heal promptly. Wise and Eller state that there is no question as to the superiority of desiccation over the cautery or radium in this condition. In the author's cases desiccation and unfiltered radium have given equally good results, but I prefer the actual cautery.

Epilation of *hypertrichosis* with this current is successful. It is more rapid than electrolysis.

In *molluscum contagiosum* desiccation is a rapid, effective method, but in profuse cases when anesthesia is required, the multiple injections of novocaine are so annoying to the patient, as well as to the operator, that the author prefers the manual expression of the contents of the lesion and cauterization of its center with pure carbolic acid.

Papillomas and *warts* (*small, common, filiform* or *genital*) of the skin or mucosae are removed by desiccation with facility and without discomfort. In *plantar warts, callosities* or *corns* desiccation has the advantage over *x*-rays and radium because it is rapid and certain. Slight pain occurs at the time of operation and is due principally to the introduction of novocaine. It may be lessened by previous anesthetization with ethyl chloride and the use of a very sharp, long needle of small calibre for the introduction of the anesthetic. The pain then following the operation is usually inconsequential. In acquired *keratodermia* of the palms and soles, desiccation is often beneficial. Coagulation by the bipolar method is preferable to desiccation on profuse, warty growths of either the vulvar or genital types.

In *lupus vulgaris* no method gives more rapid cures than coagulation followed by intensive ultraviolet radiation to the area treated. Orificial tuberculosis is similarly treated, and in *tuberculosis verrucosa cutis* and *scrofuloderma* good results are obtained by this technic. Coagulation is preferable to desiccation in the treatment of the discoid type of *lupus erythematosus*, but recurrences manifest themselves in apparently cured areas so that this method of treatment is inferior to gold thiosulphate, carbon dioxide snow, or radium. There is also a tendency to keloid formation, which further discourages its use.

Deep coagulation is a superior method of treatment for *carbuncles*. In early cases roentgen therapy may have an abortive effect, which makes surgical diathermy unnecessary. If the lesion is advanced beyond this stage, it may be removed by coagulation under local anesthesia, without bleeding. In severe cases patients should receive a general anesthetic or full doses of hyoscine, morphine, and cactine.

In chronic pyogenic *ulcer*, *chancroid*, and *granuloma inguinale*, coagulation is often an effective method of treatment, especially when combined with other therapeutic measures.

The pigments of *tattoo dyes* sometimes can be successfully removed by desiccation. A very fine spark is used, and the needle is lightly applied to the surface. After desiccation the destroyed tissue is removed by a dull curette and the surface is softened for several days by applying moist dressings. As this method seems particularly prone to cause keloidal scars, surgical excision is preferable in cases where good closure can be attained. Where large surfaces are involved the length of time required for healing is diminished by skin grafts. These grow as well after desiccation as they do following surgery.

Rhinophyma is treated by this method. In mild cases desiccation of the individual excrescences is satisfactory, but in the severer types of the disease the hypertrophic areas are neatly shaved off by the cutting current with a flattened loop as the active electrode. The treatment should be repeated at intervals until the nose gradually attains normal size.

Localized *blastomycosis*, *sporotrichosis*, *actinomycosis*, *fungating bromoderma* and other circumscribed vegetating eruptions are cured or benefited, in selected cases, by coagulation. The new growths encountered in *sarcoid*, *xeroderma pigmentosum*, and *leprosy* may also occasionally be advantageously treated by this method.

Coagulation is of foremost importance in the treatment of *neoplastic disease.* The classical method of attack upon neoplasms is first to coagulate a zone of healthy tissue surrounding the lesion, as described on page 245. For circumvallation it is frequently advisable to insert the needle electrode deep into the tissue about the neoplasm in order to effect deep destruction of a cup-shaped area. By using gentle pressure, coagulation precedes the progress of the needle point.

Surgical diathermy should be used alone only in localized nonmetastasizing tumors, in conjunction with radiotherapy upon infiltrative or malignant growths. Comparatively few tumors should be treated by one method alone, but rather by a combination of surgery, radium, *x*-rays, and surgical diathermy. The type, situation, and extent of the lesion determine which of these agents should be assembled in the campaign of treatment.

It is preferable to remove basal-cell epitheliomas by surgical diathermy in practically all cases. This method is usually sufficient to cure such lesions. Of the single methods of treatment it is the most advantageous. Clark is opposed to the additional use of radiotherapy upon localized growths, believing that the best results are obtained by depending entirely upon the surgical diathermy. Basal-cell lesions arising about the eyelids and face, even though involving bone, may be so thoroughly removed by surgical diathermy that recurrences are infrequent. It is, however, common practice to follow the removal of the basal-cell lesion by this method with radium or x-ray applications. The latter are administered as a matter of precaution against recurrences.

Upon basal-cell epitheliomas smaller than 1 cm. in diameter, desiccation is generally the preferable method of treatment. For larger lesions coagulation or the cutting current is essential.

The results in localized squamous-cell epitheliomas are governed by the grade of malignancy and the thoroughness of the treatment. In early warty circumscribed tumors the results are comparable to those obtained in the basal-cell lesions; but where the growth has been infiltrative or fixed the prognosis is poor.

Although there are some cases of squamous carcinoma that can be handled by surgery or radiotherapy alone, it is best to use a combination of these methods of treatment in almost every case. Treatment is divided into (1) disposal of the primary growth, and (2) therapy of the drainage areas. Surgical diathermy with the coagulating or cutting currents vies with the scalpel, the cautery, and radium for the removal of the primary lesion. The choice of method and the results depend more upon the experience and adeptness of the operator in each particular field than upon the method itself.

Electrocoagulation is the therapy of choice in large squamous-cell cancers on the scalp and forehead where the underlying bone contraindicates large doses of radium, and bleeding makes operation with the scalpel difficult. Cancers of the eyelid are removed most effectively by surgical diathermy, without injury to the eyeball. Growths on the face, cheek, ear, nose, lip, chin, neck, scrotum, and extremities may be handled equally well by surgical diathermy, scalpel or radium, according to the personal preference of the operator. Among a large number of lesions there are a few which seem preeminently suited to a certain method of treatment, but only wide experience can teach such indications.

Sarcoma of the skin is a relatively uncommon manifestation. In general, treatment of the local lesion coincides with the single and combined methods described above for squamous carcinoma. Fibrous and osteogenic forms require more powerful currents than softer lesions.

Treatment of the *drainage areas* varies according to the grade of malignancy, extent, and location of the tumor. Surgical diathermy holds an unimportant place in this field, which is controlled by surgery, radium, and x-rays.

Advantages and Disadvantages.—The *advantages* of surgical diathermy over other methods are:

The precise, rapid, and effective destruction of abnormal growths without bleeding.

The destruction of extensive areas without infringement upon healthy tissues.

The hemostatic action of the current sealing the blood and lymph channels.

The sterilization of the site of removal lessening the likelihood of metastasis in malignant conditions and the spreading of pyogenic infections.

The avoidance of postoperative pain.

The safe removal in many instances of tumors otherwise inoperable.

The opportunity to heal by primary intention. This is, in fact, favored by the small amount of foreign material, especially ligatures, which is left in the wound. These advantages entail rapid convalescence.

The operative advantages of hemostasis caused by the cutting current in the treatment of carcinoma are of decided value. Bleeding is practically eliminated, giving complete hemostasis without ligatures. This is of special importance in lesions of the tongue.

Biopsies made with the desiccating or coagulating currents are valueless, because the currents employed to remove the tissue cause so much injury to the piece of tissue taken for examination that it does not stain well, and in major portion is coagulated or charred. With the small wire loops, however, biopsies may be rapidly made without bleeding and without injury to the piece removed. In the case of lesions of the mucous membrane, sufficient local anesthesia is given for this purpose by absorption of holocaine from surface applications. This latter method of taking biopsies seems to afford minimum danger of dissemination of the growth into the blood and lymph channels.

Operative *disadvantages* are the frequent development of keloidal scars following the use of surgical diathermy. They seem to be less frequent after superficial desiccation than after deep coagulation. Other disadvantages are secondary hemorrhage from large vessels, which may occur at the time of operation or later during sloughing, and the injury to periosteum when the operative field is in the proximity of bone. Injury to periosteum or bone entails slow healing, septic discharges, and frequently the removal of sequestra before closure occurs.

Surgical diathermy is a method of removal of diseased tissue, and its beneficial effects do not extend outside the zone of destruction. It is a convenient and useful destructive procedure by which lesions which have heretofore been removed by other measures, may in some instances be more quickly and easily eradicated, perhaps to better advantage. In this respect it is analogous to the actual cautery and surgery, and differs from x-rays and radium, which, because of their penetrative and selective action, destroy cells far beyond the area to which they are applied. Efficacy in the treatment of cancer is increased in most cases by the judicious combination of surgical diathermy with x-rays and radium, applied both locally and to the draining lymphatics about the diseased area and in the neighboring chains of glands.

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CHAPTER XI

DERMATOSES DUE TO PHYSICAL CAUSES

The body requires a certain amount of heat, but beyond definite limits, insufficient or excessive amounts are injurious. The local action of excessive heat causes burns or scalds, and on the other hand, undue cold causes chilblains, frost bite, and congelation. Each living organism has a threshold of tolerance for infra-red radiation, exposure to excessive amounts or to the lack of enough heat producing respectively burns or frost-bite. Thresholds of tolerance exist in all body structures sensitive to electromagnetic vibrations of other frequencies such as *x*-rays, radium rays, and ultraviolet rays. The eye, which is sensitive to vibrations within the component of the spectrum known as visible light, is an example of a special sense organ which has similar limits. The skin, which is exposed to so many external physical forces, is more subject to injuries caused by them than any other organ.

The effects of these various types of radiation are influenced by certain physical laws:

1. The intensity of the radiation varies inversely as the square of the distance from a point source to the exposed surface.
2. The intensity varies directly in proportion to the cosine of the angle of incidence.
3. The latent period after the exposure and the duration of the effect of the exposure are in inverse proportion to the wavelengths of the rays.
4. The greater the intensity of the radiation, the earlier and more severe is the reaction and the longer its duration.

BURNS

A dermatitis of various degrees of intensity is caused by excessive heat. The mortality rate due to burns and scalds is extremely high in comparison with other equally common injuries. The sensitiveness of different people to heat varies, as also does the sensitiveness of different parts of the body. Dense and thick skin (palms, soles, buttocks) is more resistant to heat than is skin of softer and thinner texture (neck, abdomen, axillae). All the tissues are not equally susceptible to heat destruction.

There are six degrees of burns according to Dupuytren's classification: (1) Erythema; (2) blistering; (3) partial destruction of the skin; (4) destruction of the entire skin; (5) destruction of the subcutaneous tissue and part of the muscles, and (6) carbonization of the entire part.

The more common classification of burns consists of three so-called "degrees." The mildest, dermatitis ambustionis or first degree, is a transient erythema sometimes accompanied subjectively by local heat, swelling and pain, and followed by epidermal desquamation. Burns of the second degree, in addition to the above symptoms, are accompanied by the formation of vesicles and blebs; and burns of the third degree are so severe that there are ulceration, necrosis, and sloughing. A scald is a burn produced by moist heat, the effects being more extensive but less severe than burns which are occasioned by dry heat.

In extensive burns there may be constitutional symptoms. Prostration, nervousness, vomiting, and severe headache may occur in the milder cases. There may be varying degrees of shock during the first forty-eight hours. The onset of shock is usually rapid after the injury, but rarely may be delayed for a day or so. When present, there is extreme prostration, low blood pressure, subnormal temperature, rapid weak pulse, and moist, cold skin. These symptoms may increase until death supervenes, which usually takes place during the first two days. In other instances the symptoms of shock may gradually disappear and the patient may survive, but even then the subsequent course may be affected by tetanus, bronchopneumonia, pleurisy, nephritis, meningitis, duodenal ulcer, erysipelas, and septicemia. The burn is usually fatal if it comprises one-third of the integument, particularly if the chest or abdomen is involved.

Following burns there may be pigmentation and scarring, the latter often being keloidal. The formation of carcinoma in scar tissue is a rare but well recognized clinical fact. Cutaneous cicatrices resulting from any type of injury may become the site of carcinoma in the course of time. However, scars from burns are more liable to carcinomatous changes than other types of scars. Fissuring and chronic infection, as well as other forms of mechanical and chemical irritation, may explain many instances of the occurrence of a scar carcinoma. Implantation of foreign bodies such as gun-powder and other carbonized material may also be of etiologic importance. The carcinoma is of the squamous-cell type, and although papillary and localized at first, later becomes infiltrating. During the early stages, the rate of growth is slower than in most cutaneous carcinomas because of the poor blood supply in the cicatricial tissues. When the growth has invaded the underlying structures sufficiently, the blood supply is abundant and growth is very rapid.

Treatment.—The local treatment of burns belongs to the field of industrial surgery, where the majority of the cases occur. In general there are two methods, one dry, and the other moist. For first and second degree burns in small areas, the treatment which is least likely to be followed by keloids and which is most comfortable, is by some form of grease, personal perference being for an ointment containing 1 drachm of aluminum acetate solution (Burow's) to 1 ounce of anhydrous lanolin. Large blebs should be incised and drained. Dressings should not be changed more often than every twenty-four hours, unless there is considerable local infection. In severe and extensive burns, the entire surface may be covered by sterile thin strips of gauze saturated with this ointment or with wet dressings of 1 per cent solution of picric acid, or the patient may be treated in a continuous bath or in a cradle with steady applications of wet dressings of warm normal saline solution on the affected areas, warmth of the parts being further maintained by electric bulbs.

The use of *tannic acid* reduces toxemia and its application in dilute solution apparently prevents penetration of toxic substances into the deeper lying protoplasm. It precipitates proteins, alkaloids, some glucosides and the salts of the heavy metals. It makes a more or less stable compound with the protein elements of the body cells and fluids, and only the most superficial layers of tissue seem to be affected by its true astringent character. The precipitated proteins in the areas treated form a protective covering against chemical, bacterial, and mechanical action, and also against sensory and inflammatory irritation. This protective coating forms a support for the growth of the young epithelial cells over the exposed areas.

Before the application is made, blisters should be opened and evacuated and any loose skin removed. The areas are then cleansed with ether. Fresh solution of tannic acid (2.5 per cent in warm sterile water) should be prepared for each application as this acid in solution quickly changes to gallic acid, which is powerless to precipitate or coagulate protein. A nasal spray atomizer is used to disperse the warm solution on the areas, which are then dried with electric lamp bulbs. As each part is sprayed and dried it should be protected with gauze during the next spraying. This procedure is repeated at intervals of half an hour until the areas are covered by a thin coating of brown coagulated tissue, and then stopped to prevent too deep corrosive action of the acid. The periphery of the burned area in a first degree burn is generally colored a light chocolate brown after eight applications. In second and third degree burns the area is usually covered after eight to twelve applications; areas more deeply involved may require several more treatments. There is no pain or discomfort while the coagulum is present; consequently this method encourages rapid analgesia. No special local treatment is necessary until the coagulum is removed and the area is exposed directly to the air. Under no circumstances should wet dressings be applied over the coagulum, but fluid which accumulates under it should be removed at once through an aperture cut with scissors.

The constitutional symptoms of burns may be severe, requiring relief of pain and shock, maintenance of body temperature, and the introduction of fluids by all possible means.

Electrical Burns.—Electrical burns take about twice as long to heal as ordinary burns. The extent of local injury from them is determined by the degree of contact, and the resistance of the skin, depending upon its thickness. Skin which is clean and free from perspiration or other moisture has higher resistance. Nerves have the lowest resistance of any animal tissue, and in the following order, blood, muscle, skin, tendon, fat, and bone show increasing resistivity.

A burn caused by contact with the conductor is a true electrical burn. If the resistance of the skin is low and the contact firm, severe systemic disturbances may result from the current flowing readily into the body. The burn is round, bloodless, cold, and painless and is pale yellow in color. The edges of the lesion are slightly elevated, while the center is depressed and sometimes charred. There is no blister formation or reddening of the area and the ragged base of the burn remains firmly joined to the subjacent tissues for days or weeks. It gradually loosens and may fall off in one piece or flake off.

The "flash" or "arc" burn is more in the nature of the burn from a torch destroying deeply. Often the vaporized copper in the "arc" from the conductor causes a copper deposit on the affected surface.

SUDAMINA

This is a noninflammatory eruption of small superficial vesicles containing sweat. It occurs usually during febrile diseases in subjects of low vitality. Generally it is located on the chest or face and occasions no symptoms, the vesicles disappearing spontaneously in a few days.

MILIARIA (PRICKLY HEAT)

Synonyms.—Lichen tropicus, strophulus, heat rash, strophulus infantum.

This eruption consists of minute pruritic, inflammatory papules, and vesicles at the sweat pores. The affection occurs principally in the Tropics, but is observed occasionally in temperate climates in those who exercise vigorously or patronize Turkish or electrical baths, and in infants. Presumably the disease is of bacterial origin, for fungi and staphylococci have been recovered from the lesions.

The affection begins suddenly, simultaneous with excessive sweating. The areas itch and burn, and minute acuminate vesicopapules surrounded by a red halo appear. These rapidly develop into vesicles which contain a clear fluid and in the course of a few days dry up. The disease is more common in those who have delicate or seborrheic skins and it affects principally the chest, back, arm-pits, groins, and inframammary regions. Invalids, gouty, and obese persons are also predisposed.

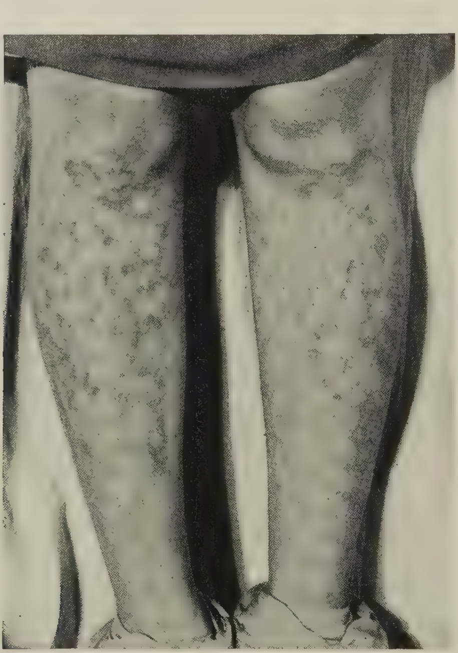

Fig. 138.—Erythema ab igne. (Courtesy of Dr. Lloyd W. Ketron.)

Treatment.—Treatment is simple, consisting mainly in the avoidance of external and internal agents which produce perspiration. The diet should be bland with the avoidance of spices and stimulants, and clothing should not be excessive, silk underwear being worn. Soap should not be used, starch water being substituted for cleansing. Immersion for ten minutes in a cool bath containing 1 pound of linit and 1 teaspoonful of a 25 per cent alcoholic solution of menthol is beneficial. The affected areas should then be treated by calamine lotion containing phenol and menthol, or a dusting powder containing $\frac{1}{2}$ to 1 per cent powdered thymol. In adults, fractional exposures to unfiltered x-rays seem to hasten recovery and to decrease the tendency to relapses.

ERYTHEMA AB IGNE

This affection is a persistent erythema and pigmentation produced by long-continued exposure to excessive heat, without the incidence of a burn.

The condition begins as a mottling due to local hemostasis and becomes a reticulated erythema which leaves pigmentation. All the various phases are as a rule simultaneously present in a patch, the color varying from pale pink to old rose, or purplish dark brown. After the cause is removed, the affection tends to disappear gradually, but sometimes the pigmentation is permanent.

Erythema ab igne is most common on the legs from habitually warming them in front of fires or on heaters. Similar changes may be produced by the hot-water bag. The condition occurs chiefly in cooks, stokers, invalids, and others exposed over long periods to the direct action of moderate heat.

CHILBLAIN

Synonym.—Pernio.

Exposure to cold causes injuries of various degrees that are somewhat similar to those produced by intense heat. In people predisposed by poor peripheral circulation even moderate exposure may produce chilblain. This is a localized erythema which occurs chiefly on the hands and feet of poorly nourished children, the onset being favored by dampness. The affection is often accompanied by burning, itching, or tenderness. The areas are bluish red, the color disappearing on pressure, and are decidedly cool to the touch, and sometimes clammy due to excessive sweating. The disorder is seasonal in occurrence, being absent in summer and present in winter. Pernio and lupus erythematosus are at times coexistent on the same or on different areas, and the latter disease may develop upon recurrent pernio.

Treatment.—The treatment is general, as well as local. The circulation should be improved by regular exercise, a diet of high vitamin content, and tonics. The lactate or chloride of calcium in doses of 15 grains three times daily is used with occasional benefit. Colloidal calcium, 1 drachm in a wineglassful of water twice daily, may be used simultaneously with the rubbing of colloidal iodine oil into the affected area night and morning. Otherwise the parts should be cleansed with hot water and massaged gently with some simple ointment each day, and should be protected against injury and exposure to cold or dampness. If the feet are affected, woolen socks should be worn at night during the cold months and during the day two pairs, and thick boots are advisable. Electric pads should be used now and then to warm the parts. Generalized, as well as localized, ultraviolet irradiation is beneficial.

FROST-BITE

Synonym.—Dermatitis congelationis.

When the soft parts are frozen and locally deprived of blood supply, the affection is termed "frost-bite." Commonly, but not always, after a part has been frozen the skin becomes erythematous and swollen or shows other changes of greater severity. The ears, nose, cheeks, fingers, and toes are sites of predilection. Various degrees of destruction similar to those caused by burns are encountered. In the first degree the frozen area becomes pallid and insensitive and, after being warmed, is erythematous, swollen, and tender. In the second degree the changes are more severe, vesicles and bullae lasting for several days after thawing. Gangrene occurs in third degree cases, followed by a line of demarcation and by a casting off of the affected portion.

Cold, hunger, fatigue, vitamin deficiency, poor circulation, winds, and dampness predispose to the affection. During the Great War soldiers in the trenches were affected during the winter by a condition called trench foot, due to exposure to dampness and cold. The severity varied from a mere paleness and coldness of a toe, with or without blister formation, to massive gangrene of one or both feet. In the mild cases, picric acid treatment sufficed, but those which were severe necessitated amputation.

Treatment.—Common advice is that the affected parts should be rubbed with snow, but Sutton calls attention to the absurdity of this method and describes the treatment recommended by Mr. Stefansson, the eminent Arctic explorer: "He employs gentle friction with the dry palm, the hand being warmed against the rescuer's breast, beneath his loose fur undershirt, as soon as it becomes thoroughly chilled. Internally, the patient is given warm, nutritious drinks (no alcohol), and strychnia if necessary."

Rothbart reports improvement or recovery in 26 out of 27 cases of frost-bite treated by hard *x*-rays filtered through 1 to 2 mm. of aluminum, with rapid response. Kroll and Fuhs have also treated a large number of patients with frost-bite by *x*-rays. The majority of the patients reacted favorably, with complete relief from the symptoms. The effect, however, was not permanent and the symptoms recurred with the onset of cold weather. The dosage used was at most $\frac{1}{2}$ E. D. of filtered radiation.

Treatment by ultraviolet rays is recommended by several authors, including Russell, and is reported to relieve the intense itching and burning promptly. The dosage is small, being barely sufficient to cause an erythema.

ANGIOKERATOMA

This is a rare affection which is often preceded by chilblains and consists of red points that proliferate to form vascular growths of pinhead size, the surfaces of which in the course of time become hyperkeratotic. The lesions are dull red or purplish black, rounded nodules. They may be single or multiple, and in the latter instance are usually closely grouped. The dorsal aspects of the fingers or toes, or the scrotum are sites of predilection. The last localization may be accounted for by varicocele, which is often present. The coexistence of tuberculosis has been frequently reported. There are no subjective symptoms.

Treatment.—Angiokeratoma may be treated by the cautery point, electrolysis, or electrodesiccation, or by the caustic action of unfiltered radium. There is little choice between these methods.

Sordello reports a case of angiokeratoma cured by *x*-ray treatment. He employed one erythema dose filtered through 3 mm. of aluminum.

LIVEDO RETICULARIS

Some persons respond to exposure to cold by the development of a reticulated purplish mottling of the skin, which is known as livedo reticularis, or as livedo annularis when the lesions are annular, and is due to vasomotor stasis. The affection occurs on the extremities from exposure to cold, and is more frequent in childhood. The pattern of the eruption is determined by the anatomical arrangement of the cutaneous vessels, and tuberculosis may be a predisposing factor. According to Lewis and Love, these vascular effects are produced by a substance liberated from the cells by the injury from cold, such substance having a histamin-like action. No treatment is usually required, but improvement of the health and circulation may be indirectly beneficial.

SUNBURN

This common discomfort occurs principally in the early summer after exposure on the bathing beaches. Blondes are more susceptible than brunettes. The individual reaction varies: in some persons a redness begins rapidly upon exposure and in a few hours assumes a scarlet tint and is associated with local burning and heat, or bleb formation; in others the reaction does not appear until the day following exposure. When the acute symptoms disappear the epidermis desquamates and the pigmentation in the skin is increased. After repeated exposures brunettes develop so much pigmentation that they are protected by it against sunburn. Indeed the formation of pigment may be so rapid and give such complete protection that tanning may be the only effect. Sunburn is caused by the ultraviolet rays from the sun and not by the heat rays, chiefly by wavelengths between 2960 and 3010 Å. u.

Although the affection is common it cannot be regarded other than as a severe injury of the skin. It is sometimes the precursor of vitiligo, telangiectasia, and lupus erythematosus, whereas infection of the blisters by pyogenic micro-organisms may lead to impetigo, and infection of the hair follicles to furunculosis.

The **prevention** of sunburn is accomplished by the application of creams containing quinine hydrochloride, bismuth subcarbonate, or disodium naphthol sulphate. These ingredients absorb ultraviolet radiation, and although their action is insufficient to prevent the effects of prolonged exposure to the sun completely, they do materially diminish them. Insoluble pigments in face powders are also preventive. Large hats and veils are protective, especially if the latter are red or black.

After sunburn has developed, the *treatment* consists of the application of soothing creams, one of the best being unguentum aquae rosae (U. S. P.) made up with 2 per cent Burow's solution substituted for the water. Ice cold compresses of mineral oil are also beneficial, pieces of gauze being wrung out in oil taken fresh from the ice-box laid upon the swollen parts, and gently rubbed with cracked ice.

During the process of aging, the skin becomes dry, thin, and inelastic due to atrophy of its appendages and elastic fibers (*senile skin*). In addition, pigmentary changes take place which are usually of the lentiginous type, but may in some persons lead to vitiligo, keratoses, and warty growths, which occur especially in seborrheic subjects, and have a tendency to become epitheliomatous. Such alterations of the skin may appear prematurely during the third or fourth decades, as all parts of the body do not show the effects of wear and tear synchronously. Persons habitually exposed to sunlight are predisposed to such changes, which are sometimes called *chronic actinic dermatitis*. Light increases the maturity of the skin and the differentiation of the cells of the epidermis.

The terms *"sailor's skin"* and *"farmer's skin"* are used for similar alterations which are manifested early and severely in these respective occupations due to exposure to the elements, especially sunlight. In this country, fishermen and gardeners exhibit similar proclivities. *Tropical skin* is in the same category.

FRECKLES

Freckles are yellowish, brownish, or black pigmented spots which occur on the skin as a result of exposure to light. They are usually produced by sunlight, being worse in the hot months, but may follow exposure to ultraviolet light from artificial sources or exposure to x-rays. The lesions may be sparsely scattered, or profuse. The condition is more common in blondes than in brunettes; but mulattoes are specially subject to the disorder. Freckles are usually 1 to several millimeters in diameter and are arranged symmetrically, as a rule on exposed portions of the skin. Some grouping may be discerned; and larger spots may form due to coalescence. Although the face, neck, shoulders, and dorsa of the hands are the usual locations of freckles, unexposed areas may occasionally be affected. Freckles do not often make their appearance before the sixth or eighth year, and from then on persist throughout life, being exaggerated each summer. Coglievina has shown a coincidence between the location of the freckles and of the points representing the thermic sense in the skin. The freckles may be a biological defensive process to protect the nerve terminal, at a particularly vulnerable point, by an extra pigmentation.

The **preventive treatment** is similar to that of sunburn. Therapeutic measures consist of the use of bleaching creams and lotions. such as given for chloasma and in the following formulas:

℞.	Camphorae	1 Gm.
	Acidi salicylici	2 "
	Lot. hydrarg. chlor. corros. in spt. vini rect. 1 : 1000	50 "

M. and L. Apply to freckles t. i. d., and when peeling begins stop applying for a few days; then repeat.

℞.	Bismuthi oxychloridi	ʒij
	Hydrarg. ammon	ʒss
	Ung. aq. rosae	℥j
	Ol. limonis	gtt. ij

M. and L. Bleaching cream.

XERODERMA PIGMENTOSUM

Synonyms.—Atrophoderma pigmentosum, angioma pigmentosum atrophicum, Kaposi's disease, melanosis lenticularis progressiva.

Xeroderma pigmentosum is a rare atrophic and pigmentary affection that begins in childhood and progresses to the early development of senile changes in the skin, which consist of lentigines, telangiectases, keratoses, papillomatous growths, and carcinoma. The disease is due to a congenital hypersusceptibility to ultraviolet light, probably owing to some deficiency of the protective mechanism. The occurrence of two or more cases in one family is not infrequent. The studies of Toyama, Vignolo-Lutati[1] and others indicate that the predisposition may be due to a tissue defect caused by intermarriage.

The regions most often affected are the face, neck, hands and arms, although a few lentigines may appear on other areas. The lesions are worse upon the face, particularly about the nose and eyes. As a rule, due to coalescence of the freckles, the entire face is dappled with pigmented spots of various tints of brown, mingled with white atrophic patches and telangiectases. Keratoses and vascular and epithelial neoplasms complete the picture. Some of these tumors are usually ulcerated or crusted, or they may be raised, discoid lesions or globular, crateriform, or even pedunculated growths. The effects of the disease on the eyes are most distressing. Photophobia and lacrimation are early symptoms; and keratitis with resulting opacities, and tumors of the lids and cornea generally supervene and cause a loss of vision, so that schooling and even simple games are interrupted and the child becomes pitiably dependent.

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[1] Quoted by Ormsby: Diseases of the Skin, p. 673.

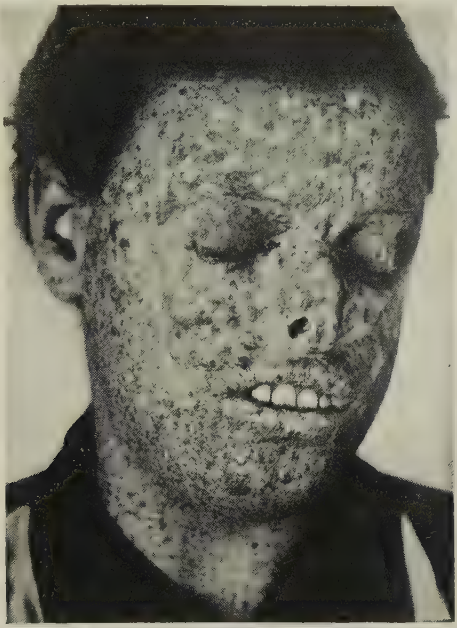

Fig. 139.—Xeroderma pigmentosum showing lentigines, atrophy, and scars, due to the removal of carcinomas. Tumors upon the corneas have already destroyed the vision. Patient's age, fourteen years.

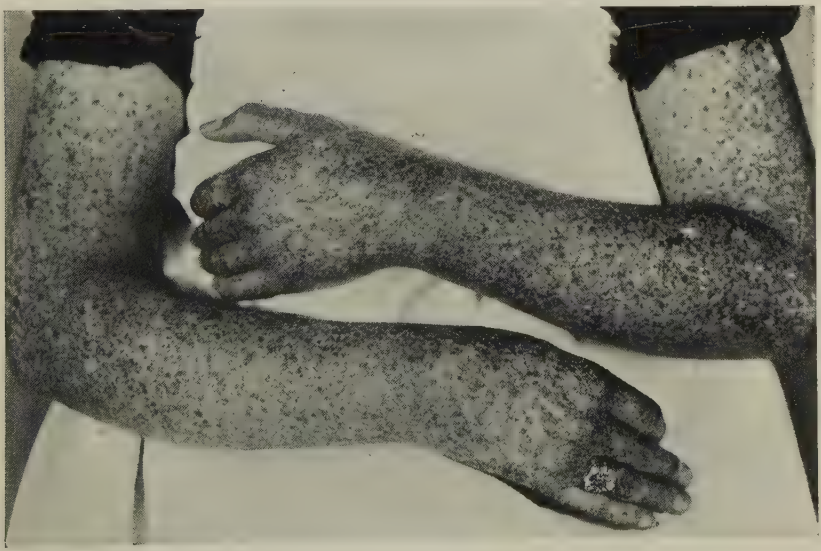

Fig. 140.—Lentigines and atrophy in xeroderma pigmentosum.

Martenstein and Bokowitsch have reported sensitiveness to different kinds of chemical rays in xeroderma pigmentosum. Bertaccini demonstrated that the unaffected skin in a case of this disease was extraordinarily sensitive to the ultraviolet rays. On the contrary, the xerodermic areas were less sensitive to the rays than normal skin. There is also particular sensitiveness to soft x-rays, an erythema being caused by a dose which normally would not have such an effect. Hard x-rays and the beta and gamma rays of radium gave normal or subnormal reactions.

No treatment is curative. The symptoms of the disorder may be ameliorated by the avoidance of exposure to sunlight and by the proper treatment of the skin growths as they develop. Figure 139 shows a girl of fourteen in whom the disease developed during the first year of life. At the time she came under my observation she had a pedunculated tumor hanging from the right upper eyelid and a dozen or more other growths on the face, as indicated in the photograph by the white scars which resulted from their removal.

HYDROA AESTIVALE

This is a vesicular and bullous affection which tends to recur each summer in childhood on uncovered parts of the body. Although both sexes are affected, the disease occurs more often in boys, beginning during the first three or four years of life and disappearing soon after puberty. Mild types of the disorder are characterized by papules or small vesicles (summer prurigo of Hutchinson), but when the eruption is severe there are bullae, impetiginous crusts, and pitted scars (hydroa vacciniforme). The lesions appear mostly on the face and the extensor aspects of the extremities, and are arranged symmetrically chiefly over the nose, cheeks, ears, and dorsal surfaces of the hands. They may arise on other areas, including the cornea, and in this location cause scars that interfere with vision. Itching and burning, as well as mild constitutional symptoms, may precede the outbreak of skin lesions, which appear in crops. These begin as erythematous macules that rapidly develop into vesicles and bullae, which in the course of three or four days dry up with the formation of adherent brown crusts. Some of the bullae become umbilicated, forming a central punctum about which are the remains of the bulla; the whole surrounded by a mildly inflammatory zone, so that the

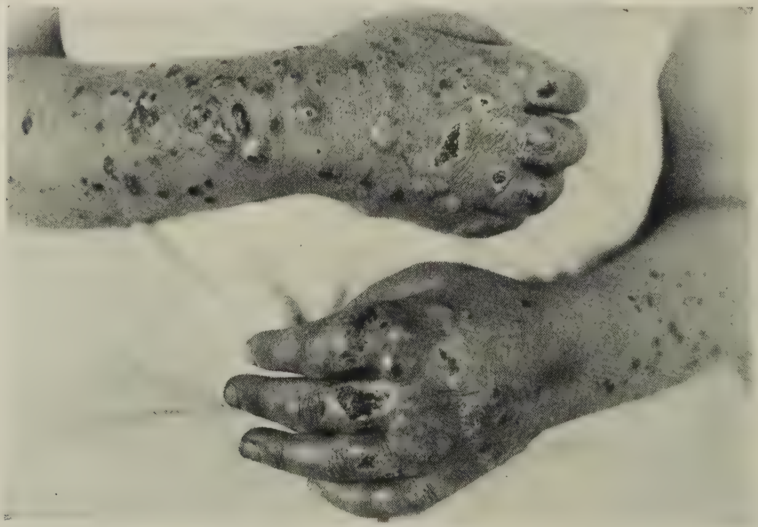

Fig. 141.—Hydroa aestivale. A bullous eruption was also present on the face. (Courtesy of Dr. Beatrice M. Kesten.)

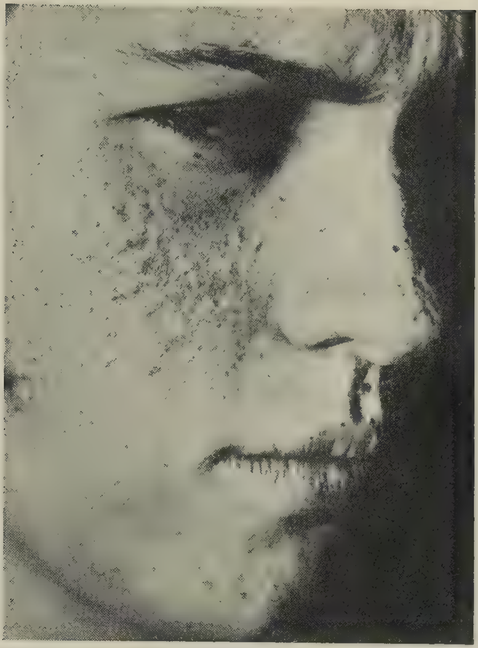

Fig. 142.—Hydroa vacciniforme.

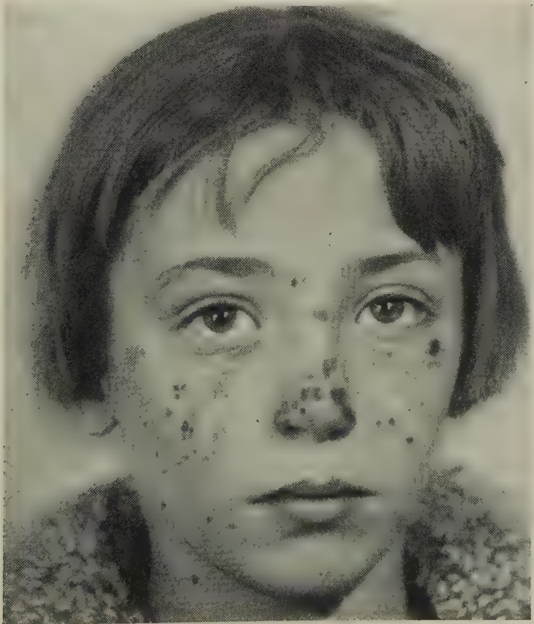

Fig. 143.—Hutchinson's summer prurigo. (Courtesy of Dr. Samuel T. Millard.)

appearance simulates a vaccination vesicle. Fresh crops of lesions appear at various intervals, which in summer may be so short that they are indeterminate.

The affection is brought about by exposure to sunlight, which may act indirectly upon photosensitive toxins in the blood stream, as is suggested by the frequent observation of hematoporphyrin in the urine. It is generally assumed that light dermatoses are evoked by the ultraviolet part of the sun spectrum, the so-called "chemical rays," but several have been reported in which other parts of the spectrum have been proved the provocative agents. Rarely, exposure to hot winds, artificial heat, or sudden climatic changes will incite an outbreak of fresh lesions. Although these causes are directly provocative, there is probably also an underlying constitutional idiosyncrasy, which is dominant in some children before puberty. The treatment is the avoidance of exposure to sunlight and the elements, and the use of soothing local applications, such as olive calamine liniment or soft zinc paste.

URTICARIA

This affection has been experimentally produced by exposure to sunlight, heat, cold, and other physical agents by Duke. The onset of angioneurotic edema owing to exposure to the elements belongs to a similar category.

ROENTGEN AND RADIUM DERMATITIS

Dermatitis due to these agents may be intentionally produced by an accurately controlled technic when warranted in the treatment of certain diseases, or may be accidentally incurred by ignorance or carelessness. Accidental "burns" from *x*-rays and radium were closely associated with the early use of them and, in the case of radium, first called attention to its action upon living matter. About five years after the discovery and medical use of *x*-rays, the first case of cancer arising upon chronic radiodermatitis was reported in a roentgenologist. During the succeeding few years numerous cases appeared in the literature. Although the *x*-ray industry has since that time grown, the dangers are now more fully recognized and precautions against them have been adopted. Possibly because of these protective measures and because cases are not as frequently reported since the unusualness of occurrence has worn off, the instances of *x*-ray burns in physicians recorded in recent literature are relatively few.

Legal actions against physicians who have used *x*-rays for diagnostic or therapeutic purposes have assumed, with their attendant publicity, a place of major importance in the statistics of malpractice insurance. Many of these claims have ridiculous foundations, based upon the efforts of some unscrupulous members of the legal profession in cooperation with credulous dissatisfied patients. More rarely, such litigations are based upon incompetent use of radiation by those lacking training and experience. Severe *x*-ray and radium burns arising under expert management are very infrequent, and there is really no excuse for them except in the treatment of neoplasms, where large doses are employed and where the hazards of the disease warrant such methods. Unfortunately, minor injuries largely of a cosmetic nature are still bound to occur in a small percentage of cases, estimated as one in five thousand.

Exposure to light is one of the determining conditions of tissue differentiation.[1] Whereas deficient amounts of light lead to tardy or incomplete tissue differentiation, excessive exposure may result in premature differentiation. Gager demonstrated that rays other than those of the sun will produce these changes. He exposed kernels of corn to radium rays, after which the seeds germinated and grew when planted. The growth, however, ceased when the plants had attained a height of only a few inches above the ground. Examination of the tissues showed they had been prematurely differentiated into somatic tissues, and the plants had died of senility before sexual maturity had been attained. "Radiologists have come to realize that exposure to the *x*-rays causes the skin to become senile. Those who have worked with radium and who have exposed their fingers to its rays, have a senile condition of them; due to the fact that there has been an overdifferentiation of the tissues." As pointed out by Bovie, "if one interferes with the rate of tissue differentiation in a growing organism the whole process of development may be thrown out of order and the organism may develop into a monster."[1] An abnormal rate of differentiation and an overdifferentiation of epithelial cells are essential characteristics of cancer.

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[1] Bovie, W. T.: The Effect of Light on Growth and Development, Arch. Phys. Therapy *x*-Ray Radium, 7: 521, Sept., 1926.

Similarity Between Radium and *x*-Ray Dermatitis.—Inflammatory reactions due to *x*-rays and radium have many points of similarity, although the onset, course, and end-results vary greatly. These variations depend upon the intensity and penetration of the radiation and upon individual predisposing factors, discussed later.

In general, the clinical manifestations resulting from excessive exposure to either *x*-rays or radium are analogous to changes produced by sunlight and artificial ultraviolet light, "dermatitis actinica." All these agents are forms of electromagnetic energy. After an incubation period following exposure the skin becomes erythematous and swollen, or blistered, with accompanying changes in pigmentation, which represent an acute burn. In the course of years, continued exposure to sun rays (especially in persons subject to seborrhea) results in thin, atrophic skin with pigmentation and keratoses, noted in sailors and those in agricultural pursuits, usually upon the hands and face. Changes in the skin due to *x*-rays and radium are a more severe type of such manifestations, in which additional sclerotic and ulcerative tendencies may occur.

Thompson and Wakeley call attention to one exception in the similarity between roentgen and radium dermatitis, which is subungual hyperkeratosis, not seen in the case of *x*-ray burns. Much stress has been laid on the manifestation of the nail bed at its free edge being markedly thickened as a characteristic of radium dermatitis. The author has observed subungual hyperkeratosis from roentgen rays and is inclined to think this exception is not well founded.

The dermatitis produced by radium is affected by the penetration and the dosage. As alpha rays are unable to penetrate the epidermis, their effects upon the skin may be disregarded. The beam of beta rays is composed of electrons of various individual velocities. The soft (slow) beta rays cause superficial skin effects largely limited to the epidermis and the papillary body. Such reactions consist of local erythema, occasionally with slight swelling and itching, exudation, and exfoliation of the epidermis. These superficial reactions may simulate, in clinical appearance, a severe roentgen dermatitis of second degree, but unlike the latter, the superficial radium dermatitis heals in two or three weeks, in this manner resembling a *w*-ray reaction.

Reactions from gamma rays and *x*-rays are very similar, especially since the gamma-ray spectrum includes wavelengths encountered in roentgen therapy. In the treatment of dermatological conditions, the roentgen radiations used are generally longer in wavelength and less penetrating than gamma radiation. As the penetration and dosage decrease, the incubation period between initial exposure and onset of dermatitis diminishes, and the more superficial and temporary are the injuries.

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[1] Hertwig, O.: Versuche an Tritoneieren über die Einwirkung bestrahlter Samenfaden auf die tierische Entwicklung zweiter Beitrag zur experimenteilen Zeugungs- und Vererbringslehre, Arch. f. Mikr. Anat., 82: 54–55, 1913.

Injuries resulting from gamma rays and very penetrating *x*-rays lead to deep destructions which are slow to heal, and the incubation period preceding their onset is relatively long, being inverse to the size of the dose.

Prophylaxis of Radiodermatitis.—1. *General Methods.*—Care in the estimation of the dosage and administration of treatment should prevent serious forms of radiodermatitis. Most serious burns result from careless omissions of filters, failures to watch exposure time, or repetition of treatment without observing proper intervals. Such mistakes occur more often from carelessness than from ignorance.

2. *Ultraviolet Light.*—This has been used as a prophylactic measure and as a therapeutic agent in irradiation injuries.

Sampson reports the use of enormous doses of roentgen rays without skin damage in cases which have been previously subjected to severe treatments with an ultraviolet lamp. Consequently, he employs ultraviolet radiation before and also after *x*-ray exposures. He believes, however, that roentgen-ray burns can be prevented through ultraviolet radiation by after-treatment alone, which must be such as to produce severe actinic reactions. Rulison claims he prevented serious sequelae resulting from an overdose of roentgen rays by an after-treatment with a Kromayer lamp in a case of senile keratosis of the face. When the mistake was detected, the patient was submitted to repeated actinic exposures (seven) with gradually increasing doses. No *x*-ray reaction appeared until the twelfth day—and then only a slight one. The author does not consider these experiences convincing. The results can be explained by faulty technic or by the fact that it is often possible to administer several times the standard erythema dose of *x*-rays to senile human skin without producing more than a mild visible reaction. Ultraviolet radiations, regardless of how they are employed, are of no practical value as a prophylactic against acute or chronic radiodermatitis. This contention is supported by recent studies.[1]

Ultraviolet radiation as used by Pfahler, Klauder, and Martin in their experiments with rabbits did not prevent *x*-ray dermatitis. On the contrary, the ear which received combined treatment with ultraviolet rays and roentgen rays showed a more severe reaction than the control ears which received the same amount of roentgen-ray treatment alone, to a maximum reaction in which ulceration occurred and the ear sloughed off.

From numerous clinical experiments it has been found that successive exposures to ultraviolet rays resulting in a well-marked tanning do not materially increase the tolerance of the skin for *x*-rays. Ultraviolet light does not prevent the depilatory effects of *x*-rays. In clinical and experimental work erythema doses of ultraviolet given almost simultaneously with erythema doses of *x*-rays distinctly enhance the effect of the latter. From these observations and because of close physical association of ultraviolet rays to *x*-rays it is believed that actinotherapy is of no benefit as a prophylactic against *x*-ray burns. Moreover, ultraviolet light is contraindicated in the treatment of the acute stages of *x*-ray and radium injuries, *e. g.*, the first and second degree reactions, because the rays increase the effects of the already excessive radiation and retard healing.

The stimulative value of ultraviolet light and small doses of the beta rays of radium applied to the edges of chronic indolent ulcers is well known. Frequently after minute doses of either one of these agents the epithelium proliferates and healing is rapid. Ultraviolet light used for such purpose or to eradicate telangiectasia by blistering doses is in a different category from a prophylactic agent, and the two should not be confused.

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[1] MacKee, G. M., and Andrews, G. C.: The Ultraviolet Ray as a Prophylactic Against Radiodermatitis, J. A. M. A., 85: 1715–1719, Nov. 28, 1925.

To summarize: 1. Vigorous actinotherapy, resulting in acute reactions, at or near the time of roentgenization, may enhance the result of the latter.

2. Tanning of the skin by actinotherapy does not materially increase toleration for roentgen rays or radium.

3. Preliminary, generalized actinotherapy, even when continued for a long time, does not appear materially to decrease "radiosensitiveness."

4. It is possible to administer several times the standard erythema dose of roentgen rays to normal human skin without effecting more than a mild visible reaction, especially in elderly people. Ignorance of this fact may account for the erroneous assumption that actinotherapy is a prophylactic against roentgen-ray and radium injuries.

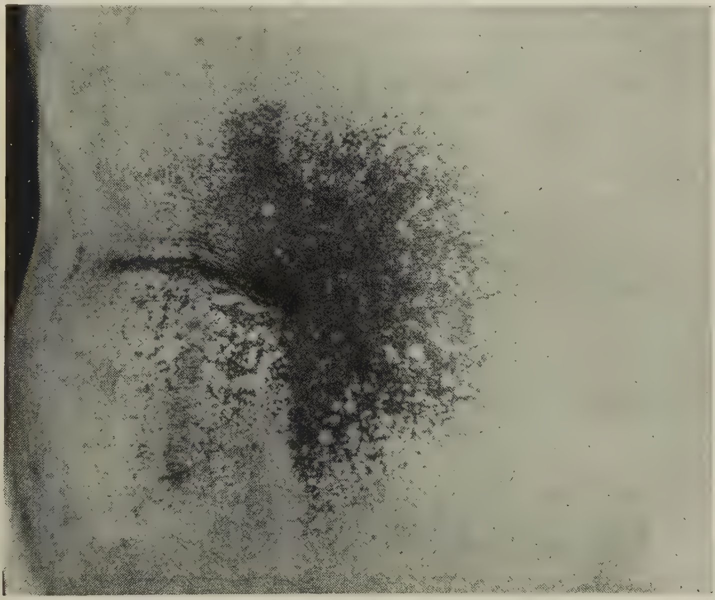

Fig. 144.—Roentgen-ray telangiectasia.

5. Actinotherapy is of some value in the treatment of chronic ulcers and telangiectasia caused by roentgen rays or radium.

6. Ultraviolet rays, regardless of how employed, are of no practical value as a prophylactic against acute or chronic radiodermatitis.

7. Probably a combination of the ultraviolet ray and the roentgen ray is more likely to be followed by sequelae such as telangiectasia than when the roentgen ray alone is employed.

Factors Predisposing to Radiodermatitis.—The factors predisposing to radiodermatitis which have been in major portion mentioned in Chapter VI (under Skin Toleration) may be outlined as follows:

1. *Inherent Character of the Skin.*—Dry or oily seborrhea increases the susceptibility of the skin to radiation changes and late sequelae. Blondes are more susceptible to erythema than brunettes, Titian blondes being most radiosensitive. On the contrary, pigmentary changes are more easily produced in brunettes and the darker races. The texture of the skin has some

bearing upon its sensitivity to radiation; fine, thin skins responding to smaller doses than the coarser type.

2. *Age, Sex, and General Condition.*—There is a noticeable difference in the radiosensitivity of adults and children. Generally one considers the therapeutic dose for children to be no more than three fourths the adult therapeutic dose. Infants and children under three years of age are still more susceptible and will only tolerate one fourth to one half an adult erythema exposure. In older persons (above sixty years), especially above the seventy-fifth year, the tolerance is high. It is often necessary to give a dose of three or four unfiltered erythema exposures to basal-cell lesions in elderly people to effect a therapeutic result comparable to that produced by half the dose in younger adults.

The skin of females in general is slightly more radiosensitive than that of males.

The radiosensitivity is affected by the general nutrition. Individuals having a thick panniculus are more tolerant than the thin and undernourished. Persons suffering from chronic wasting diseases, such as cancer, diabetes, and tuberculosis, have a lowered resistance. Moderate radiation reactions in these cases may lead to chronic ulcerations which are slow to heal. When the circulation of the skin is good the response to radiation is prompt. The hyperemic or congested skin is the most sensitive, whereas skin that is pale and anemic reacts less readily.

3. *Location of Area in Body.*—There are considerable variations in susceptibility to radiation in different body areas. The mucous membranes are more sensitive than the skin. Next to the mucous membranes, the flexor surfaces where there is warmth and moisture, are sensitive, especially the axillae, the inner surface of the thighs, and the bend of the elbows. The face is exceedingly susceptible to radiation. The skin over the wrists, knuckles, bend of the knees, and anterior neck is more sensitive than adjacent areas. The palms and soles, especially when the horny layer is thick, have a high degree of tolerance, but perhaps the least sensitive part of the body is the scalp. Whenever the skin of these areas overlies bony or cartilaginous structures with a relative absence of subcutaneous fat, its toleration to large doses is lowered. This is especially important in reference to the scalp, forehead, auricle, nose, mandible, and digits.

4. *Local Pathologic Conditions of Skin.*—The reactivity of the skin is appreciably changed by the presence of certain types of local pathologic process. Radiosensitiveness is increased by local congestion, inflammation, or infection. Voluminous infiltrations may augment the reaction to such an extent that local necrosis results from comparatively moderate dosage. On the contrary, scales, crusts, horny thickening, and edema or the presence of radioresistant cells (epithelioid, giant, nevus, or adult connective tissue, or epithelial tumor cells), decrease the radiosensitivity.

5. *External Factors.*—Observations made by Wintz show that every radiated part of the body exposed to "a quantity of rays exceeding the limit of tolerance typical for the cells by one third, forms an area of lessened resistance to irritants applied to it." He goes on to say that if to the effect of *x*-rays upon the cells another irritant is added which normally would cause no injury at all, the skin will respond to the summation of the two irritants with a distinctly recognizable reaction.

(*a*) Irritating Local Medication: The topical use of certain chemical substances increases radiosensitivity. These may be roughly divided into metallic ingredients and those not containing metals. By the former the amount of secondary radiation, which may be related to the increased effect of exposure, is augmented. All these drugs are most active in the form of ointments in predisposing to the occurrence of radiodermatitis. They have been enumerated in detail in Chapter VI.

(*b*) PHYSICAL CAUSES—HEAT, COLD, AND PRESSURE: The application of intense heat or cold to an area preceding or following radiation is apt to enhance or diminish the reaction. Hot-water bags, ice-bags, and hot or cold compresses are therefore inadvisable. Persistent pressure upon the irradiated part of the skin incites similar changes.

(*c*) PREVIOUS OR SUBSEQUENT EXPOSURES TO RADIANT ENERGY: The effects of sunlight and ultraviolet light in this regard are analogous and have been discussed under prophylaxis. As stated there, both of these agents in general augment *x*-ray and radium reactions. Long-continued exposures to small doses of sunlight and ultraviolet light produce thin, dry, and wrinkled skin, telangiectasia, lentiginous spots, and keratoses (chronic actinic dermatitis), which are very similar to chronic radiodermatitis. There is possibly slightly increased tolerance in persons who have become deeply pigmented from exposures to actinic radiation, which is too small to be of practical importance.

Skin which has previously been the site of radium or roentgen reaction has an increased susceptibility to further irradiation. Such radiosensitiveness may last for years after the reaction. The increased susceptibility applies not alone to further radiation, but also to other external physical or chemical irritants, and for this reason is probably not a specific alteration but rather a biological change.

Areas which have been irradiated with fractional doses below an erythema and not visibly injured show no appreciable changes in radiosensitiveness to subsequent application of radium or roentgen therapy, providing that accumulation is avoided.

(*d*) GALVANIZATION: A single long-continued galvanization of the skin, especially if accompanied by the introduction of metals by iontophoresis, produces an increased reactivity of the skin.

6. *Internal Medication.*—The radiosensitivity of the skin may be influenced in minor degrees by the internal administration of serum and metallic substances.

Galewsky reports an interesting case in which the skin was apparently sensitized to arsphenamine due to roentgen radiation. The eruption appeared upon a rectangular area on the chest three weeks subsequent to roentgen-ray examination for pulmonary tuberculosis, and one week later universal arsphenamine dermatitis became manifest. Apparently injections of horse serum may slightly increase the tolerance to radiation.[1]

Latent Period.—An interval of several days intervenes between the exposure to radiation and the onset of visible skin reaction. This interval is called the latent period. The term is applied mostly when erythema doses are used, but a similar interval exists between exposure and functional or therapeutic manifestations when fractional or suberythema doses are employed.

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[1] Auer, J., and Witherbee, W. D.: Studies on Decreasing the Reaction of Normal Skin to Destructive Doses of *x*-Rays by Pharmacological Means and on Mechanism Involved, Jour. Exper. Med., 33: 791–813, June, 1921.

The duration of this interval is affected largely by the quality of the radiation, the skin tolerance of the subject, and the magnitude of the dose. In general, the softer the radiation and the larger the dosage, the shorter is the latent period.

With unfiltered *x*-rays this latent period usually lasts from five to seven days. With softer radiation, either from the beta rays of radium or the supersoft *x*-rays, the latent period is short, being a matter of hours. The penetrating radiation from filtered roentgen rays or radium causes no skin manifestations for several weeks after exposure (two to six weeks).

The latent period may be unduly prolonged in rare instances without an apparent explanation. When this happens the process is called a "delayed reaction." It is important to bear in mind the possibility of a delayed reaction. Failure to do this may result in superimposing two doses of magnitude upon the same area without a proper interval and lead to a burn.

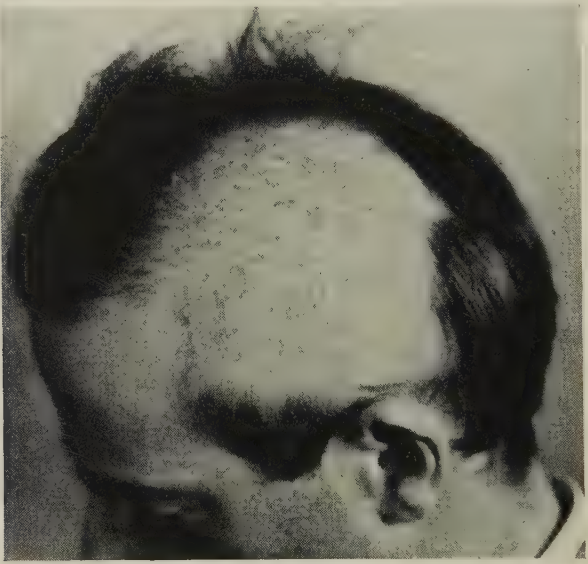

Fig. 145.—Permanent alopecia due to roentgen rays.

During the latent period numerous changes are observed histologically and by means of the capillary microscope. The skin vessels become dilated and congested, and the blood flowing through them is retarded, and about their walls there develops an infiltration of lymphocytes. These changes are associated with swelling of the connective tissue and inter- and intra-cellular edema. Microscopically, vascular dilatation, and lymphocytic infiltration may be observed for several hours, days, or weeks before the appearance of grossly inflammatory changes.

The phenomena of the latent period are difficult to explain. They belong to the field of general biology and are not a specific radiation problem. Presumably the radiation effects are immediate, and such grossly visible clinical changes as ultimately appear are tissue reactions to them.

Local Clinical Reactions.—Pigmentation following radiation is especially influenced by individual characteristics. It is common after reactions of all degrees. In brunettes diffuse homogeneous tanning may ensue from a fractional unfiltered roentgen treatment or even from a static hyperemia. A similar small exposure may produce numberless lentiginous spots of various sizes and depths of brownish color in those subject to freckles. In some the freckles may be of light brown color and rather large; in others they may be very dark brown or black and pinhead sized.

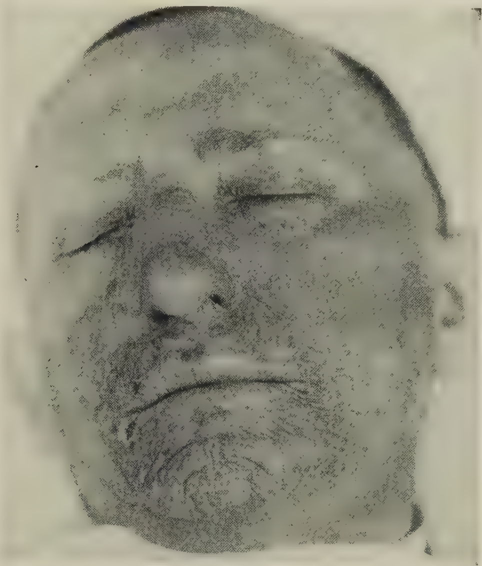

Fig. 146.—Atrophy caused by roentgen rays in the treatment of sycosis vulgaris.

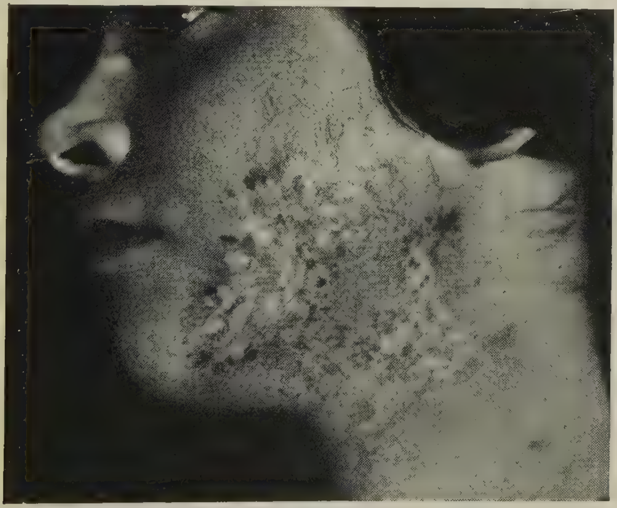

Fig. 147.—Telangiectasia and atrophy produced by the roentgen-ray treatment of hypertrichosis. (Courtesy of Dr. Nathan T. Beers.)

Pigmentation or tanning usually disappears in a few weeks, but may persist much longer. Not infrequently the hyperpigmentation endures for a few years, especially in brunettes. The author has a tanned square on his forearm from a test exposure of 1 E. D. given six years ago. After very severe reactions the pigmentation may be permanent.

In dark skins, especially in Ethiopian and Mongolian races, depigmentation instead of hyperpigmentation may ensue from intensive exposures. Such depigmentation is permanent. It must be particularly guarded against in the treatment of keloids, where it is customary to use fairly large doses.

Hyperpigmentation, either diffuse or in the form of lentigo, is not an important index of skin toleration, but it should not be completely disregarded in the treatment of acne and other benign dermatoses where cosmetic effects are important. Cases which show an early tendency to pigmentation should receive a little more conservative treatment than those in which this biological reaction is not manifest.

The Following Cutaneous Changes Represent the Transient Functional Inhibitions Which, During Fractional Treatment, Precede the Onset of True Radiodermatitis.—Although mild in character, they are of the greatest importance in roentgen therapy, because they are about the only clinical means of estimating the biological response of normal skin structures (sebaceous and sweat glands, hair follicles, and blood vessels) to doses which are suitable for the radiotherapy of benign dermatoses.

(*a*) *Inhibition of Functional Activity.*—The mildest form of clinical reaction is a dryness of the skin caused by inhibition of the activity of the sudoriferous and coil glands. This effect—which may be temporary or permanent—is noticed chiefly in treatment with small doses over a long period at frequent intervals. Permanent inhibition may result from repeated fractional filtered exposures of *x*-rays or radium without causing an erythema.

Dryness, then, is the clinical evidence of the mildest skin reaction. It denotes that almost an erythema dose has been administered, and serves as a warning that further radiation must be given cautiously with close observation of the skin for evidence of irritability or erythema.

(*b*) *Epilation.*—The hair is epilated by suberythema exposures of all except very soft radiation. Lanugo, scalp and other hair is affected. Defluvium usually occurs sixteen to twenty-one days after the administration of an epilating dose, being earlier in the coarser hair than in the downy or lanugo hair. About the fourth week after exposure the hair ceases to fall.

Defluvium from suberythema exposures is always temporary. Even if there are mild reactions the hair will usually regrow. It is necessary to bear in mind that an erythema, however mild, may not be followed by regeneration. Erythemas are therefore to be avoided in cases requiring temporary epilation.

Quality of radiation also affects the character of these mild reactions. With Bucky's tube in which *x*-rays of 2 + Å. u. are produced by 7 to 8 kv., the action is so superficial that the hair follicles are not appreciably affected. As a result, this reaction consists of a superficial erythema. It appears within a few hours after treatment and disappears in the course of one or two weeks. Erythemas from unfiltered radium may also be so superficial that they do not cause epilation. Aside from these extremely soft radiations, defluvium occurs with all doses sufficient to produce an erythema.

Permanent alopecia is apt to follow severer types of radiodermatitis and even well-marked erythemas, although occasionally a few scattered coarse hairs are seen growing in atrophic, telangiectatic areas, which have resulted from large doses.

Regrowth of hair usually occurs without delay. Frequently it begins to grow in two or three weeks after it has fallen. In general it may be said that regeneration takes place one to four months after treatment. However, in cases which have shown no growth in this time, some coarse hair may grow years later.

The regrowth following even small doses may differ slightly from the original. Frequently it is more profuse and occasionally it is curly in instances where it was formerly straight, or may have a slightly different color or lustre. It may grow more rapidly and profusely in previously diseased areas than upon normal skin.

(c) *Irritability.*—The serial administration of small doses of radiation may eventually lead to a pronounced vascular irritability of the skin resembling a mild degree of dermographism. In this state rubbing or slapping of the treated area or the application of warmth gives rise to rapid hyperemia. There may or may not be slight itching.

Skin irritability of this nature results from a larger dose than is required to produce inhibition of the sweat and sebaceous glands. It may occur with an epilating dose, especially if attempts at permanent epilation are undertaken. The greatest importance attached to this type of skin irritability lies in its significant warning that an erythema may develop at any time.

The local clinical reactions which have been described are not usually included in a definition of radiodermatitis. Inflammatory conditions of the skin produced by roentgen rays or radium rays (radiodermatitis) are best divided into (*a*) acute dermatitis from a single large dose or multiple large doses given at frequent intervals, and (*b*) chronic dermatitis as a sequel of acute dermatitis or from frequently repeated small doses given over a long period.

Acute Radiodermatitis.—For descriptive purposes three degrees of acute dermatitis are usually designated:

1. *First Degree Radiodermatitis.*—This is the mildest form of inflammatory reaction. It consists of an erythema associated with slight burning and itching, which entirely disappears after a few days or weeks, either leaving no trace or being followed by pigmentation or slight desquamation.

Erythemas from *x*-rays and radium vary considerably according to the dosage and the quality of radiation.

In general, the softer the radiation and the larger the dose, the sooner after exposure erythemas make their appearance. With unfiltered radium and very soft *x*-rays produced from Bucky's tube, an erythema usually appears within twenty-four or forty-eight hours, and often earlier. This is especially true if the dosage is fairly large. One hundred millicurie minutes of radium in a bare tube frequently causes an intense erythema within a few hours, often followed by vesiculation within twenty-four hours.

With unfiltered *x*-rays from the usual type of dermatological therapeutic apparatus, an erythema exposure produces a pale pink hue in the treated area, beginning about five to seven days after exposure and lasting for approximately three weeks. About seventeen days following such an exposure, epilation is noticeable. The erythema thus appears earlier than the defluvium and continues after the hair has fallen. The dosage necessary to produce an erythema varies somewhat according to topography and individual factors, previously discussed. A certain dose unfiltered may provoke an erythema upon sensitive parts, such as the inner thighs, and yet produce an epilation of the scalp without erythema. With a larger dosage the onset is sooner, the intensity greater and the duration longer, the affected area generally becoming swollen and tender.

With filtered x-rays such as are employed in dermatology, an erythema exposure usually does not manifest itself until after an interval of one and a half to three weeks. The erythema persists for three to six weeks. Epilation accompanies filtered erythema doses, the hair usually becoming loosened about three weeks after exposure.

The range of clinical reactions to radium in therapeutic doses extends from the very superficial erythema, which follows the use of unfiltered radium in small doses, through numberless modifications according to the dosage and quality of radiation. The proportion of beta rays regulates, to a large extent, the intensity of the superficial reaction. When soft radiation is eliminated by increased filtration and distance, the interval between exposure and onset of erythema is prolonged. In heavily filtered radium therapy, pronounced tissue effects, such as the disappearance of large tumor masses, are frequently not accompanied by marked erythema. When radium is filtered through brass and applied in therapeutic doses, from a distance of 1 or more centimeters, the skin reaction does not appear for two to four weeks subsequent to irradiation. With interstitial therapy by platinum needles and gold tubes a similar delay occurs. The greater the filtration, the deeper the inflammation extends. The vascular dilatation and leukocytic infiltration of the reaction from heavily filtered radium not only affect the skin, but often extend deep into the muscles or underlying structures.

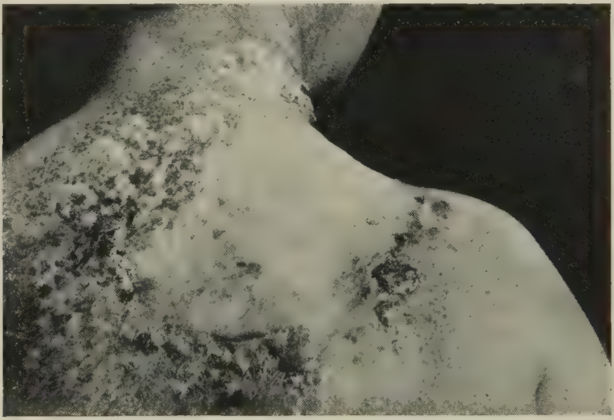

Fig. 148.—Severe x-ray burn producing atrophy and epithelial hyperplasia. (Courtesy of Dr. Charles A. Porter.)

Edema of the skin frequently accompanies the clinical reactions of x-rays and radium. It is commonly observed subsequent to the application of unfiltered radium, in which case an urticarial-like wheal may precede the erythema by a few hours. The edema is proportionate to the magnitude of the dosage and the softness of the radiation, larger doses leading to intense vesiculation.

The appearance of inflammation disproportionately early is a sign suggestive of overdosage, although it seems to be an idiosyncrasy of some individuals to manifest an unduly premature erythema, without ascertainable cause. When an erythema from filtered radium or roentgen radiation, however, appears within two or three days after exposure, it is almost invariably an evidence of overtreatment. Clinically these unusual reactions must be differentiated from static erythemas.

The delayed appearance of an erythema seems also to be a personal idiosyncrasy. The delay does not usually suggest undertreatment, but is to be regarded largely as a peculiarity of little significance. The chief importance attached to delayed reactions is that they are liable to mislead the operator into thinking that he has insufficiently treated the area and into superimposing, without a long enough interval, another dose upon the already adequately irradiated lesion.

SEQUELAE.—First degree reactions are generally followed by epithelial desquamation, pigmentary changes, and temporary or permanent dryness due to impairment of the sweat and sebaceous glands, or alopecia. After the course of months, usually about eighteen months subsequent to treatment, but sometimes as early as twelve months or as late as ten years, slight cutaneous atrophy accompanied by telangiectasia is likely to supervene.

2. *Second Degree Radiodermatitis.*—In radiodermatitis of the second degree the erythema is more marked and the edema so intense that vesiculation results. Itching and burning are pronounced. The erythema of second degree reactions develops two or three days earlier than in the case of first degree reactions. At the beginning the color is scarlet. In the course of a few days the edema becomes intense, causing exudation, vesiculation, and erosion of the epidermis. Crusting of an impetiginous character ensues; hair in the irradiated area falls out about three weeks after exposure. The alopecia is likely to be permanent. The function of the sebaceous and sweat glands is impaired for an indefinite period in most cases. When the fingers are affected, the nails may desquamate.

The rapidity of the appearance of the reaction depends largely upon the quality of the radiation and the dosage. With supersoft x-rays or unfiltered radium, vesiculation may occur a few hours following the manifestation of an erythema, whereas with hard radiations, one or two weeks may elapse between the appearance of the erythema and the vesiculation. With the type of unfiltered x-rays used in dermatology there is frequently an interval of several days between the onset of the erythema and that of vesiculation. With filtered x-rays and filtered radium applied at an increased distance, the onset of the vesiculation is further delayed.

The duration of second degree reactions is, as a rule, between one and three months. Several months after healing, atrophy and telangiectases are likely to ensue. It is not uncommon for the skin to assume a parchment-paper appearance. In the course of time lentiginous spots and keratoses usually develop, and after years the latter may change into cancers.

3. *Third Degree Radiodermatitis.*—When the reaction is severe enough to cause necrosis and ulceration, it is classified as third degree radiodermatitis. With modern methods, local injuries of this kind from x-rays rarely occur. Such a roentgen accident generally results from carelessness. On the other hand, with unfiltered or lightly filtered radium or supersoft x-rays, the necrosis which leads to ulceration is often purposeful and therapeutic.

As with the other degrees of reaction, the time of onset is inversely proportional to the magnitude of the dosage and the softness of the radiation. It is associated with vivid erythema, edema, vesicle or bulla formation, pain, and sloughing. The pain is especially severe when cartilage, periosteum, or bone is involved. With soft radiation vesiculation always precedes ulceration by a few hours or days. With hard radiation the breaking down of tissues into an ulcer may follow an erythema and vesiculation so transient that neither is marked, consequently necrosis comes on suddenly, without much forewarning. This is especially apt to happen when cross-firing has been employed. Healing is delayed at least for months, often indefinitely. When cartilage or bone is involved it does not take place until the sequestra are removed. When healing does occur the resultant scar is dry, shiny, hairless atrophic, telangiectatic and liable to break down spontaneously or from the slightest trauma.

Ulcerations of this character are so indolent that they frequently never heal. They are subject to secondary infection, and after years of irritation from this cause, from local remedies and motion of the injured part, cancer springs into existence. Small keratoses are prone to develop in the affected areas, especially where the skin is atrophic or telangiectatic. Such keratoses are dry, hard, glazed, dark brown or black, like little plugs, which, when broken off or removed, leave pits and gradually regrow, or if traumatized or infected, form ulcers that often develop into carcinoma as time passes.

In cases in which the reaction has been caused by penetrating radiation, the injury to the subcutaneous connective tissue is so severe that a dense rather diffuse local sclerosis or "boardlike thickening" occurs. These sclerodermatous changes may limit the motion of articulations. The tissue is practically avascular, due to a destructive endarteritis of the vessels. Ulcerations which develop in such environments from either trophic or minor mechanical causes are naturally indolent and subject to malignant changes. In severe cases the atrophy is so pronounced that gangrene may result from trophic disturbances.

Chronic Radiodermatitis.—Chronic radiodermatitis may develop from the acute phases of a third degree reaction as the result of a single tremendous overdosage, or appear as a late sequela of a preliminary burn (moderately acute radiodermatitis) followed by frequently repeated small exposures to the softer rays over a long period. Even in the absence of a primary acute radiodermatitis, repeated exposures during a number of years may lead to chronic tissue changes.

This form of radiodermatitis is usually encountered in operators who are handling radium or *x*-rays. This type, sometimes called professional radiodermatitis, usually affects the hands. In those who use *x*-rays these lesions are not uncommon over the knuckles. In radium workers the flexor surfaces of the right thumb and index finger are most often affected. Not only the skin but the tendons, bones, nerves, and sexual and blood-forming organs are liable to suffer from professional misuse of radiation.

On the hands the skin becomes dry, thin, smooth, and shiny, is sensitive to the slightest trauma and generally itches and burns. These subjective symptoms are worse in the winter months. Lentiginous spots or diffuse pigmentation is present. The nails may become striated, discolored, and brittle, or there may be transverse or longitudinal ridging, with delayed growth. Suppurative paronychia from secondary infection of the tissues of low resistance may lead to shedding of the nails. As the dermatitis progresses, telangiectases and hemorrhagic puncta result from the small capillaries.

Associated Clinical Manifestations.—Several forms of dermatitis not directly due to the action of the radium or *x*-rays are liable to occur from the exposures.

1. Static hyperemia, also called electrical erythema, may result imme-

diately or within a few days after exposure to x-rays (see page 128, Chapter VI). Such hyperemia is transient and of no serious consequence. It is accompanied frequently by mild subjective symptoms and may be followed by increased pigmentation.

2. Electrical burns may arise from sparking of the electrical high voltage current to the patient.

3. The inflammatory exudates from second or third degree reactions to radium or x-rays may irritate the surrounding skin, causing an eczematous condition, with erythema, oozing, crusting, and itching. It probably begins as a chemical irritation and often becomes secondarily infected with the Staphylococcus pyogenes. Purulent manifestations develop often in the absence of proper care. The eczema is apparently auto-inoculable and clinically resembles infectious eczematoid dermatitis.

4. Follicular, erythematous, or pustular eruptions not infrequently appear during the epilation of hairy parts. These are occasionally generalized, spreading to nonirradiated areas. They have been especially noted in the treatment of tinea of the scalp and are probably due to pyogenic microorganisms spread by the falling of the hair. These eruptions are to be differentiated from trichophytide.

5. Radiotherapy may cause temporary exacerbations of the disease under treatment, with consequent augmentation and spreading of the local inflammatory process. The irritation is more pronounced from large doses or in acute inflammations.

x-Ray and Radium Cancer.—Both clinically and experimentally different kinds of tumor formations occur after radiation injuries. Whereas the usual growth is an infiltrating squamous carcinoma, sarcomas have been observed in both human beings and animals. The different types of neoplasm from this irritant illustrate that through variations in wavelength or biological response, sometimes the epithelium and at other times the connective tissue may be the part most affected.

Clinically the neoplasms usually arise (1) from an infiltration around and beneath a keratosis which has been subject to prolonged irritation, either chemical or physical; (2) from the edge or floor of chronic ulcerations produced by third degree reactions, and (3) from persistent fissures in dry atrophic x-ray or radium skin. The most common location of such fissures is on the dorsolateral surface of the distal phalanges extending proximal from the cuticle. In this position they are subject to chronic infection and frequent irritation of other sorts. Radiation cancer also arises (4) from sclerodermatous type of radiodermatitis by the development of a nodule, which rapidly ulcerates and forms a fungating growth. (5) Chronic diseases such as lupus, psoriasis, and eczema which have been treated with repeated small exposures over a long period may lead to a cancerous condition. Cancer may develop upon nonirradiated lupus, but the combination of this type of radiation and the disease seems to increase the tendency to its incidence. Such growths may not be purely radiation cancers.

It has been stated that radiation cancer is of relatively low malignancy, but such a conception is untenable and based on the restraining influence of scar tissue upon the spreading of the cancer cells rather than on the clinical or histologic character of the tumor itself. The tumors vary greatly in the details of their microscopical characteristics, such as maturity of their cells, degree of tissue reaction, amount of cornification, and pearl formation. Apparently they may remain quiescent or fairly inactive for a long period and then suddenly spread to the lymph channels with great severity. Variations in the degrees of the malignancy, from a clinical viewpoint, may be modified by histologic observations, especially connective tissue changes such as encapsulation by fibrosis.

x-Ray and radium cancer is one of the few well-defined examples of the artificial production of cancer in man. It is an occupational disease. The onset after a single acute severe burn is exceedingly rare. As a matter of experience, a combination of one or more burns with subsequent repeated small exposures, especially of soft radiation, is an essential factor in the development of radiation cancer.

In nearly all cases there is a long latent period between the radiation injury and the onset of cancer. It is rarely less than four or five years, and usually fifteen to twenty years. If the predetermining factor in the development of cancer is inherent in the tissue cells, it must be presumed that the injury from the radiation initiates a gradual increase in the potency of this factor, which slowly, through a period of years and numberless generations of cells, ultimately becomes predominant.

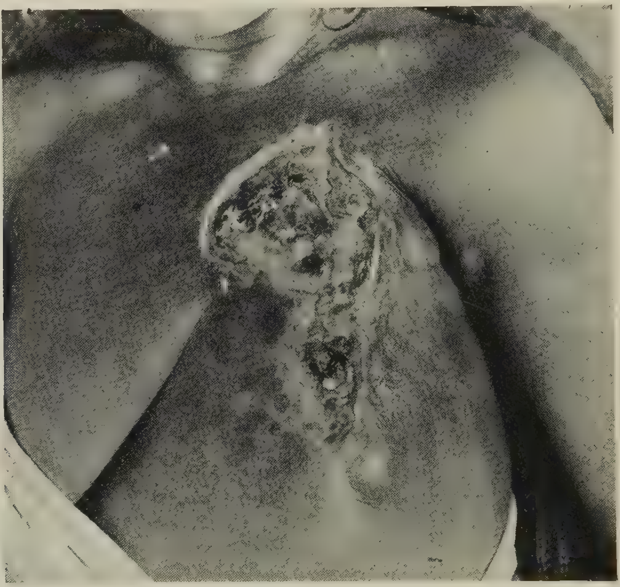

Fig. 149.—Roentgen ulcer produced by excessive treatment of carcinoma of the breast.

Treatment of Radiodermatitis.—No method is known which will prevent a reaction after an erythema exposure has been given. Ultraviolet light as a prophylactic has been discussed in the beginning of this chapter. Together with numerous medicinal agents which have been suggested for this purpose, it is valueless. The importance of avoiding irritating local applications, both before and after radiation, cannot be overemphasized.

Treatment of Acute Dermatitis.—In *first degree* reactions where the dermatitis consists of an erythema with perhaps slight edema, astringent emollients are used. The area must be protected from trauma and infection. The following formulas are suggested:

℞.	Liq. alumini acetatis (Burowii)	1 part
	Lassar's paste (without salicylic acid)	2 parts
	Adipis lanae	3 "

M. and S. Apply thickly locally and cover with gauze.

℞. Past. zinci mollis, N. F.

℞.	Ung. butesin picrate (Abbott)	1 per cent

℞.	Liq. alumini acetatis,	
	Aquafor (Metz)	āā ℥iv

Menthol, phenol, and other antipruritics are well avoided, unless there is a specific need of them.

The affected area should be cleansed with mineral oil, olive oil, or unscented cleansing cream

In severe reactions where there is considerable itching and burning ice cold compresses applied now and then will give prompt relief. Wet dressings of olive oil or witch hazel may be substituted.

In *second degree* reactions of mild character the above applications which contain liq. alumini acetatis are also beneficial. For more severe forms of dermatitis in which vesiculation is pronounced, soothing astringent antiseptic lotions are recommended. These may be modifications of calamine and zinc lotion, the best of which is the formula suggested by Pusey, called calamine liniment. The formula and pharmaceutical details for this are herewith given:

℞.	Tragacanthae	℥j
	Glycerini,	
	Phenolis liquefacti	āā ♏x
	Zinci oxidi,	
	Calaminae praeparatae	āā ℥j
	Olei olivae	℥iv
	Olei bergamottae	♏xx
	Aquae	q.s. ad. Oj

"A wide-mouth bottle should be used, one large enough to allow a free shaking of the quantity of emulsion to be made –for example, a quart bottle for a pint of emulsion. The bottle should be clean and dry. The phenol, glycerin, and oil of bergamot are first added to the olive oil. The entire quantity of oil is then placed in the bottle, the bottle corked, and the oil shaken up in the bottle in order to be sure that the entire inner surface of the bottle and cork becomes covered with a film of oil. The tragacanth (finely powdered) is then added little by little to the oil and the mixture is thoroughly shaken until a yellowish, opaque mixture is formed. If this is properly done the tragacanth becomes evenly mixed through the oil. This is essential in order to get a good emulsion. Then about 4 ounces of water are added and the mixture vigorously shaken. This will produce a yellowish, creamy emulsion. The calamine and zinc oxide are mixed dry and then stirred up with the remaining 8 ounces of water in a separate container. The easiest way to do this is to take a wide-mouthed bottle, put in the zinc oxide, calamine, and water and shake it. This mixture of powder and water is then added, an ounce or two at a time, until the quantity is brought up to a pint. After each addition of the suspension the emulsion is vigorously shaken."

When the vesicles are large they should be slit and drained, and wet dressings of 1 per cent solution of aluminum subacetate or a solution of boric acid applied. If pain is severe, tinctura opii 3 per cent or cocaine 0.5 per cent may be added to these solutions.

Ointments should be strictly avoided in second degree reactions because they do not absorb the profuse exudate which spreads laterally beneath them. Ambrine and paraffin dressings are objectionable for the same reason. Such exudate is liable to produce eczema upon the surrounding healthy skin. Eczema from this source is often severe and may become generalized. It can be avoided only by strict cleanliness, which is best accomplished by the use of olive oil or boric acid solution.

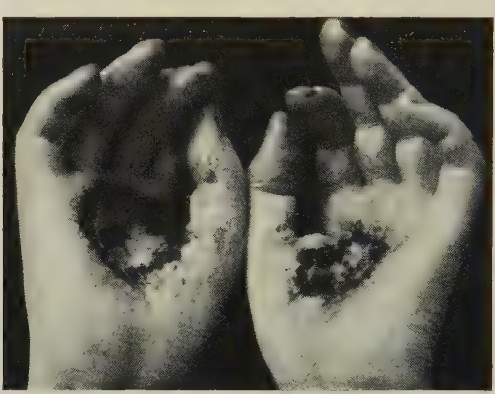

Fig. 150.—Chronic ulcerative radiodermatitis of the palms caused by excessive treatment of eczema by x-rays and radium. (Courtesy of Dr. Charles A. Porter.)

After the exudative stage has subsided creams may be used. The following formulas have seemed to give the most comfort. To these, 5 or 10 per cent anesthesin may be added:

℞.	Petrolati liquidi	℥j
	Cerae albae	ʒij
	Zinci oxidi,	
	Ac. boric	āā ʒj
	Aquae destillat	ʒiij
M. and S.	Soothing cream.	

℞.	Petrolati liquidi	℥j
	Cerae albae	ʒij
	Pulv. boracis	gr. vj
	Aquae destillat	ʒiij
M. and S.	Cold cream.	

Treatment of *third degree* reactions is divided into treatment suitable during the acute stages and treatment proper for the chronic stages.

During the acute stages the treatment is very similar to that already described for second degree reactions. In addition, attempts must be made to relieve the pain, which is often excruciating. Local analgesics should be tried, but are generally useless. The internal administration of codeine or morphine is usually necessary. Coal tar derivatives and bromides are of no benefit. Dry heat or the application of an ice-bag intermittently over a wet dressing sometimes gives relief. In severe instances the nerve supply to the affected area has been blocked by the injection of alcohol into the nerve sheath. Although a painful and difficult procedure, its accomplishment is likely to entail relative comfort for two or three months.

Treatment of Chronic Dermatitis.—The treatment of *third degree radiodermatitis in the chronic ulcerative stage* is essentially surgical. Zinc chloride, incitamin, ultraviolet radiation, and radium are of some value in the treatment of small burns, but it is a matter of general experience that these procedures, which often cause temporary improvement, are ultimately a waste of time.

For proper surgical treatment, general anesthesia is usually necessary. When possible the ulcer with the induration about it is excised, with a wide margin extending in all directions to healthy tissue. An elongated elliptical incision is used for the removal of small burns in favorable situations. After undercutting the edges the operator closes the skin by sutures. When the location and extent of the burn make it impossible to perform complete excision, the lesion should be removed as thoroughly as possible.

Davis prefers "small deep grafts" in most cases applied some days after the excision. Oozing is likely to be so great that immediate grafting is rarely possible. Pedunculated flaps are preferable under certain conditions, but care must be exercised in the use of these owing to the danger of sloughing in the flap caused by the widespread endarteritis. Because of the rich blood supply in muscular tissue, it offers the best foundation for grafts.

About three weeks after healing has occurred, local massage should be instituted on the area and continued for several months.

Pain in radiodermatitis is due mostly to the obliterative endarteritis and to overgrowth of the corium. It is a local affair and is therefore not due to neuritis above the lesion. Porter calls attention to the prompt relief of pain by local excision, and the author has had striking instances of such relief in his own practice.

Excision can be performed with a scalpel, cautery knife, or endotherm cutting current. In the majority of cases the scalpel is preferable because one is guided in the extent of the excision largely by the vascularity, and this is not recognizable on account of searing of the tissue when the cautery knife or electrothermic current is used.

Although early operation is advisable, it is difficult, in the acute stages to estimate the extent, especially the depth, of the injury. It is usually expedient to wait a few months until the lesion has become more or less inactive before instituting operative treatment. Further delay is not advisable. If an ulcer has not healed in six months, it should be excised.

Certain methods of treatment other than surgical are useful for chronic ulcerative radiodermatitis. These more conservative methods are particularly serviceable in selected cases of ulcerations upon the face and hands, and in other locations, and upon small ulcerations of only two or three months' duration. Zinc chloride solution in strengths ranging from 1 to 5 per cent painted locally t. i. d. tends to form a clean granulating surface, which expedites healing. Regular, progressively graduated exposures to sunlight improve the local circulation and the tendency to heal. These two methods may be combined, and used even before the slough separates.

After separation of the slough, various mildly stimulating measures are of value. Ultraviolet mercury air-cooled or water-cooled therapy is very effective. It often produces astonishing results and makes surgical measures unnecessary. After all dead tissue has been cleaned off to permit penetration of the energy, a suberythema dose should be applied daily to the affected area and continued for two or three months. Overtreatment with ultraviolet energy is deleterious, destroying the proliferating immature cells and delaying the healing indefinitely.

Reyn prefers carbon arc light concentrated through a system of quartz lenses cooled by flowing water. These are applied with compression to the part that it may be made bloodless in order to insure an effect by the light upon the deeper layers of the skin.

Mild medicinal stimulants such as 1 to 3 per cent ichthyol or balsam of Peru in lotion or paste may be used at times, although such applications must be carefully regulated, as overstimulation leads to destruction and increase, instead of decrease, in the size of the ulcer. Silver nitrate 1 per cent solution may be used to stimulate granulations. It seems to give the best results if applied just prior to each ultraviolet treatment. Veiel has obtained rapid healing and permanent cures by the use of warm flaxseed poultices applied frequently to the ulcerated surface for a period of two to four months.

Infection of areas of chronic radiodermatitis is common. Mild superficial infections by saprophytic organisms are controlled most effectively by Dakin's solution or its modifications. Fulminating infections require rather radical incision and drainage, or excision.

As *chronic professional radiodermatitis* occurs principally among manufacturers and therapeutists, the treatment is always hindered by the continued exposure of the patient and frequently by a careless attitude of disregard based upon familiarity with the work. In the incipient stages, where the skin is dry, telangiectatic, atrophic, hyperkeratotic or fissured, cocoa-butter creams, glycerinated hand lotions, and emulsions of lanolin, soap-bark, or quince seeds relieve discomfort and form a protective coating against trauma. Gloves should be worn to guard the hands against exposure to cold or sunlight. If the patient will not wear gloves, creams containing quinine hydrochloride 10 per cent, esculin or naphthol disulphonic acid are fair substitutes. When the affection is further advanced and keratoses have developed, these should be promptly treated.

Through the constant effect of radiation the fingernails become dry, rough, split, and discolored. Pope recommends the following treatment:

> The hands and nails are thoroughly cleansed with brush and soap and bathed for a few seconds in very hot water followed by very cold water, and then thoroughly dried. The hands, especially about the edges of the nails, are thickly spread with olive oil, and gloves are worn during the night. This treatment is followed consistently each day for six or eight weeks, and after that continued indefinitely at less frequent intervals. Pope believes the rapid change from hot to cold water is especially beneficial.
>
> The author has found goose grease and cocoa-butter creams of benefit.

℞.	Goose grease..........	60 per cent
	Olei theobromatis......	10 "
	Adipis lanae...........	12 "
	Cerae albae...........	5 "
	Petrolati albi..........	10 "
	Aquae destillat. .q.s. ad.	100 "
	Ol. rosae (geranium) for odor.............	q.s.

℞.	Olei theobromatis......	20 per cent
	Cerae albae............	10 "
	Adipis lanae...........	6 "
	Ol. amygd. dulc.........	50 "
	Aquae destillat. . q. s. ad.	100 "

Over the knuckles, superficial erosions and ulcerations, which result largely from vascular obliteration, trauma, and secondary infection are likely to supervene. Healing is best accomplished by rest of the part and very small, feebly stimulating doses of ultraviolet light or unfiltered radium.

> (Five to 20 millicurie minutes per square centimeter once weekly by a flat glazed applicator or by moving a glass bulb or tube to and fro over the ulcerated surface.)

All persistent fissured, ulcerated, or keratotic patches, especially if infiltrated, should arouse suspicion of cancer, a condition which supervenes insidiously upon such areas.

Epithelioma.—Porter and Davis, who have had extensive experience in the treatment of *x*-ray and radium burns, find that cancer rarely develops upon deeply destructive lesions resulting from a massive overdose, but occurs more frequently in burns from many exposures over a long period of time in the treatment of such chronic diseases as lupus, eczema, and psoriasis, and most frequently upon the hands of roentgenologists who have been subject to varying degrees of chronic radiodermatitis for many years.

The treatment of radiation cancer differs only slightly from that of other forms of squamous carcinoma of the skin, discussed in Chapter XXX. For the primary lesion surgical methods are naturally preferable to further irradiation. Either the scalpel, cautery, or surgical diathermy may be used. Amputation is frequently resorted to in the involvement of the extremities. In isolated cases, removable radon implants have been used locally with striking success. When this treatment is successful, it leaves pliable scars and less deformity than results from surgical treatment. Removal of the lymph glands into which the part drains is indicated. Such removal is followed by high voltage x-ray therapy applied to the drainage areas.

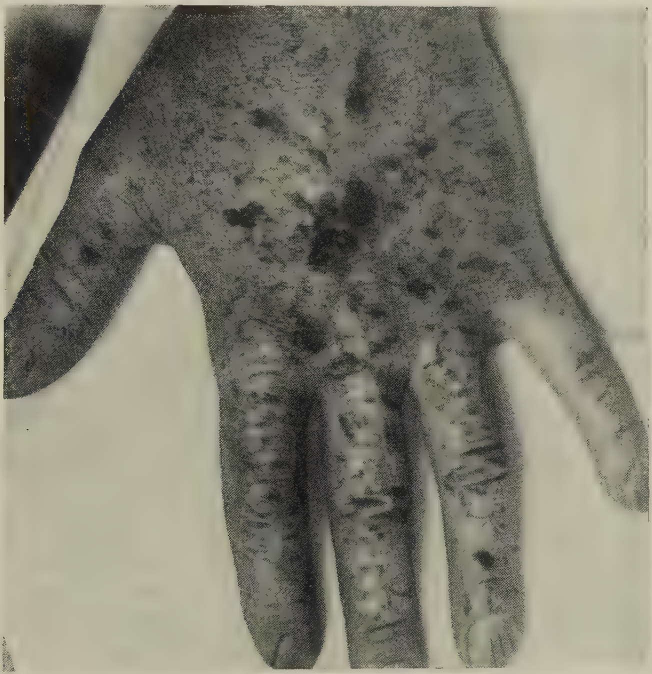

Fig. 151.—Chronic professional radiodermatitis. Note atrophy, keratoses, and carcinoma. (Courtesy of Dr. Charles A. Porter.)

In order to avoid possible malignant degeneration of patches of *keratosis* it is advisable to destroy these areas as soon as possible after their appearance. Surgical excision of keratoses with closure or with grafting is the method of choice in any case where a microscopical examination is indicated. It is imperative that all keratotic spots be excised, regardless of their extent.

Although the beta rays of radium have been widely used for the treatment of x-ray and radium keratoses, more recently electrical desiccation has been shown to be an infallible method, which is applied with facility and does not expose already overirradiated tissue to further radiation. Excellent results ensue from the use of either of these methods in the treatment of keratoses, but probably radium should not be considered as satisfactory as complete destruction by electrodesiccation or the actual cautery. Desiccation is accomplished by the use of a small electrical spark applied to the keratosis through the air from the point of a small needle. The spark is excited by a high frequency Oudin current. A most delicate, accurate effect is obtained. For small keratoses no local anesthesia is required, but for larger lesions, especially those which are surrounded by infiltration, the use of novocaine and adrenalin is necessary to insure complete extirpation. After desiccation the dried lesion is removed, and the area is covered with a boric ointment dressing overnight.

Unfiltered radium from flat glazed applicators or emanation in a glass bulb or glass tube invariably produces good results. The dose should be 100–300 millicurie minutes applied to the area of the keratosis with pressure. The lesions may also be cured by *x*-rays or gamma rays, but the best results are derived from the soft radiation of unfiltered radium. Prior to radium treatment, the keratosis should be trimmed flat with a very sharp razor, and softened by a dressing of boric ointment over night. The surrounding skin is shielded almost to the edge of the lesion. Within a day or two after exposure an erythema develops, and this persists from two to three weeks, during which time the keratosis involutes or falls off.

If healing does not ensue promptly from the application of balsam of Peru or silver nitrate to *fissures*, these lesions should be treated by electrodesiccation, after which a wet dressing should be applied.

Telangiectasis belongs to the late injuries caused by atrophy of the superficial skin layers and secondary vascular proliferation. In the present state of our knowledge, it seems that the mildest erythema may at times be followed by these sequelae, and that they rarely occur without preceding erythema. This fact illustrates the importance of keeping the dosage below an erythema in the treatment of all diseases in which cosmetic results are of importance.

The removal of telangiectases can be accomplished only by mechanical destruction of the vessels. This is done most effectively by electrolysis or a small galvanocautery, although other measures, especially ultraviolet light, carbon dioxide snow and radium, have been used for this purpose.

Electrolysis is a suitable method for small areas. The technic resembles that employed for hypertrichosis, except that the needle is inserted into the lumen of the ectatic vessel instead of into a follicular orifice. The needle holder is connected with the negative pole of a galvanic current, and the positive pole is connected to a sponge electrode held in the patient's hand. About 1 ma. of current is employed for one or two minutes. If the needle is inserted directly into the vessel, hydrogen bubbles may be noticed coursing down the length of the latter. As soon as the line of the vessel becomes white, the application is stopped, the needle is inserted into another vessel, and the same process repeated. With care, scarring can be avoided. It is advisable not to treat vessels close together in the same session. Although the vessels have disappeared through the use of electrolysis, many of them again become visible after a few hours when the edema has subsided. It is usually necessary patiently to repeat treatments in order to destroy the telangiectases entirely and completely.

For larger patches local anesthesia with novocaine is necessary. It is administered by iontophoresis with the most favorable result, as hypodermic injections lead to a swelling of the tissue which causes transient obliteration of the vessel. After thorough anesthesia the vessels are destroyed by a galvanocautery, the finest needle-pointed application, scarcely glowing, being used. To avoid scarring, too much should not be attempted in one treatment.

Blistering exposures of ultraviolet light, especially with the water-cooled mercury lamp, produce definite improvement of telangiectases, but complete cures by this method are exceedingly rare. Continued blistering exposures cannot be given without endangering the skin to other injuries. The author treated the following case, which is illustrative of this fact.

I. K., a physician, who had been treated for acne of the back with unfiltered x-rays by another physician, had received twenty fractional exposures at weekly intervals. When the patient came under observation, there were profuse telangiectases over the upper back and shoulders, but the skin otherwise showed little change as the result of radiation. He had been aware of the presence of the lesions for the past five years. In addition, the skin was somewhat dry but there was no itching, no evidence of thinning or atrophy, and the lanugo hairs were still present. The patient, being a physician, had read of ultraviolet therapy for telangiectases. The water-cooled mercury vapor lamp was used with compression, in doses sufficient to produce blistering, and these treatments were continued assiduously for almost a year. Although the telangiectases gradually disappeared, they were not completely gone, the improvement being about 50 per cent. The treatments were finally stopped because circular patches of dry, glistening, parchment-like, atrophic skin developed in the areas exposed. At the present writing, which is four years later, the circular atrophic patches which were treated by this method can still be distinguished, and although they contain fewer vessels than the intervening untreated areas, the general appearance of the back is unimproved.

Only careful methods can be employed for the atrophic sequelae from over-irradiation. *Parchment-like skin, leatherized skin,* or *sclerodermatous* or *board-like thickening* are of the same process in which degenerated structures are replaced by fibrous tissue. Protection against trauma, gentle massage, warmth, and mild stimulation with sunlight or artificial ultraviolet light usually result in gradual improvement if the endeavors are persistent. Local emollients should be prescribed. Spontaneous improvement rarely occurs; and not infrequently complete excision and skin grafting are indicated.

In *alopecia* nothing will restore the hair after radiation has destroyed the follicles. Cosmetic pencils, false switches, or transformations are frequently used.

Dryness and *wrinkling* of the skin are largely produced by inhibition of the coil and sebaceous glands, and by degeneration of the white elastic tissues and blood vessels. The condition is transient or permanent, depending upon the degree of injury of these structures. Treatment implies local tonic measures such as massage, the high frequency vacuum electrode, sunlight, and heat, together with protection from drying soaps or exposure to cold, and the liberal use of creams.

℞.	Ol. amygd. dulc	℥ij
	Cerae albae	℥ss
	Cetacei	℥ss
	Cocoanut oil	℥j
	Adipis lanae	ʒij
	Aquae rosae	ʒij
	Tinct. benzoin	gtt. x
	Ol. amygd. amar	gtt. x

M. and S. Massage cream.

℞.	Petrolati liquidi	ʒiv
	Petrolati albi	ʒiij
	Paraffini	ʒj
	Oriental oil	gtt. iij

M. and S. Cleansing cream.

℞.	Emuls. amygdalae	60 per cent
	Emuls. tragacanthae	15 "
	Aquae hamamelidis	15 "
	Tinct. benzoin	1 "
	Ol. amygd. amar	2 "
	Aquae	q.s. ad. 100 "

M. and S. Softening lotion.

The following formulas will hasten the disappearance of freckles or diffuse *pigmentation* from radiation. It is advisable to institute a routine of using a carbon tetrachloride solution for cleansing the skin, followed by a bichloride of mercury lotion in the daytime and a strong bleaching cream at bedtime.

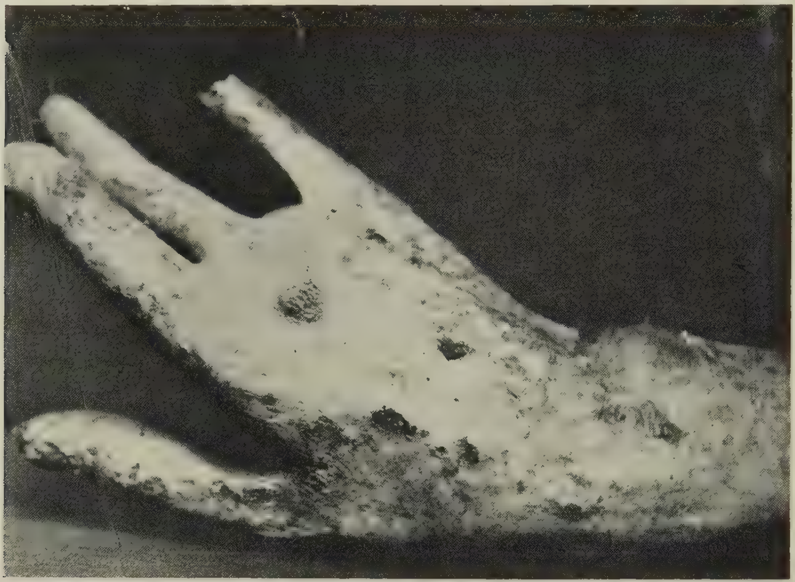

Fig. 152.—Physician's hand injured by *x*-rays. The ring finger and the termina phalanx of the fifth finger were amputated because of carcinoma, and the patient died of pulmonary metastases after fifty operations. (Courtesy of Dr. Charles A. Porter.)

℞.	Persionis (Cudbear)	gr. ¼
	Carbon tetrachlor	ʒij
	Alcoholis	℥ij
	Mentholis	gr. iv
	Sodium boratis	gr. xx
	Glycerini	ʒj
	Aquae hamamelidis	℥j
	Ol. aurantii florum	gtt. vj
	Ol. rosae	gtt. viij
	Aquae destillat . . . . . . q.s. ad.	℥viij

M. and S. Cleansing lotion.
Use with cotton.

℞.	Hydrag. chlor. corros	gr. iv
	Mentholis	ʒij
	Glycerini	℥vj
	Alcoholis	℥iv
	Oil of lilac	ʒj
	Ac. boric sat. sol . . . . q.s. ad.	C. j

M. and S. Bleaching lotion.

℞.	Hydrarg. chlor. corros	gr. vi
	Bismuthi oxychloridi	ʒij
	Adipis lanae	℥ij
	Unq. aquae rosae . . . . q.s. ad.	viij
	Oil of jasmine	gtt. xv

Add bichloride to oil and ʒj alcohol.

Melt all other ingredients and when sufficiently cool, add the oil solution.

S. Bleaching cream.

Depigmentation is usually permanent. It is infrequent and occurs only in dark skinned individuals after severe reactions. Nothing is known which will restore the lost pigment to the skin. Depigmented areas may be colored by the careful use of a skin stain, which is applied coat upon coat until the desired depth of color is attained. The best cosmetic result is obtained by

TABLE 22

CLINICAL EFFECTS OF x-RAYS UPON THE SKIN IN SUPERFICIAL THERAPY

Dosage.	x-Ray Reaction.		Sequelae.		
Suberythema (within the margin of safety and used in all treatments with following exceptions).		Irritability, epilation.	None (generally speaking).		
Erythema or greater (used only upon malignant tumors and indolent granulomas; excessive for other dermatoses).	*First aegree radiodermatitis*	Above and erythema, edema, epidermal exfoliation.	Atrophy: dryness alopecia wrinkling pigment changes	telangiectasis	
	Second degree radiodermatitis	Above and vesiculation, crusting.	Above and parchment skin	keratoses	chronic irritation—mechanical, chemical, or due to infection, leading to carcinoma.
	Third degree radiodermatitis	Above and necrosis, breaking down.	Scleroderma	ulceration	

The course of events following radium treatment corresponds closely to this table, with the following minor exceptions when soft radium rays are used: (1) The prodromal symptoms of pigmentation, dryness, and irritability to rubbing and slapping are substituted by more or less itching. (2) The epilation dose is larger than the erythema dose. These effects also result from Bucky's supersoft x-rays.

then rubbing in a colored vanishing cream, followed by the application of a colored liquid powder. Before the stain is used, all oil should be removed from the affected area by sponging with alcohol. The following formulas may be varied to match the tint of the unaffected skin. The ingredients of the stain are:

℞.		
	Bismarck brown	q.s.
	Henna	q.s.
	Carmine	5 per cent
	Fluidextract of walnut (Juglans)	20 "
	Aromatic spirit of ammonia	25 "
	Alcohol	q.s. ad. 100 "

M. and S. Apply lightly coat upon coat until desired color is obtained.

℞.		
	Stearin	ʒj
	Glycerini	ʒj
	Potass. carb.	gr. x
	Aquae destillat	ʒvj
	Ol. rosae	gtt. ij

Color as desired with calamine, carmine, henna, or Bismarck brown q.s.

M. and S. Tinted vanishing cream.

℞.		
	Zinci oxidi	℥ss
	Rice powder	℥j
	Magnes. carb	ʒij
	Talc. (Squibb)	℥iss
	Zinci stearatis	ʒiss
	Ol. jasmine	gtt. iij
	Diluted alcohol	q.s. ad. ℥iv

Color as desired with cosmetic brown, calamine, or Bismarck brown q.s.

M. and S. Liquid powder.

Microscopical Pathology of Radiodermatitis.—It is not possible in this work to survey more than briefly the histologic findings of the dermatitis produced by *x*-rays or radium. These two agents cause tissue reactions of a similar character. All soft rays exert a more or less destructive action, and only as the hardness increases does selective action become apparent, so that with filtration the effects of radium and roentgen rays are approximate, but as pointed out by Ewing, it is doubtful if they ever become identical.

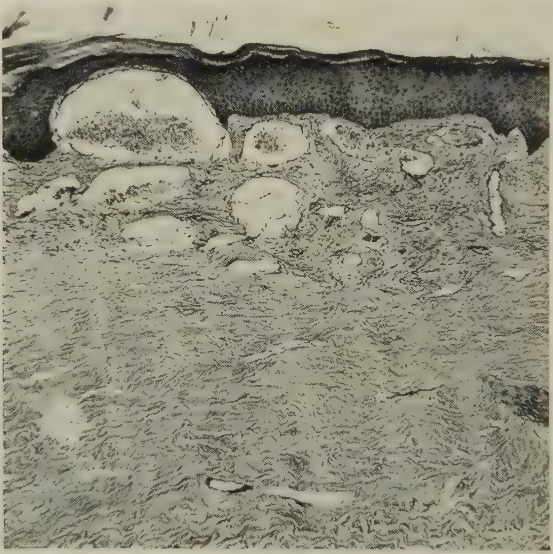

Fig. 153.—Radiodermatitis. Note atrophy of the epidermis, degeneration of the connective tissue, and dilatation of the blood and lymph vessels with degeneration of vessel walls. (Courtesy of Dr. Gerald M. Machacek.)

The earliest alteration found in the skin which is exposed to these agents is a mucinoid degeneration and fragmentation of the collagen noted throughout the corium and subcutaneous tissues, especially about the skin appendages and in the walls of the large blood vessels. The principal changes in these are characterized in the early phases by dilatation and congestion, and later by degeneration of the walls, thrombosis, and obliterative endarteritis. The dilatation and congestion are manifest a few hours after exposure and gradually increase to the height of the period of clinical reaction. These vascular alterations are accompanied by an exudate of serum and lymphocytes into the surrounding tissues, the latter being at first distributed at focal points in the perivascular zone. As a result of lymph stasis the tissues become generally swollen, especially the endothelial cells of the blood and lymph vessels, and, as stated before, the collagen. The edema becomes more pronounced and affects the epidermis, being both intercellular and intracellular. Together with the increased amount of humoral exudate, the round cells in the perivascular infiltration grow more numerous and form a distinct collar throughout the length of the vessels.

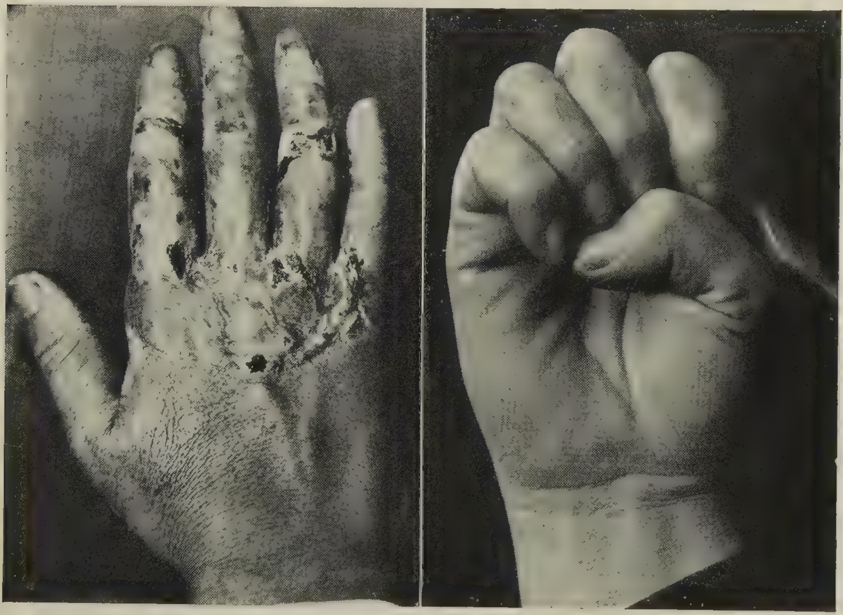

Fig. 154. Fig. 155.

Figs. 154, 155.—Roentgen burn from treatment of eczema, and result of skin grafting. (Courtesy of Dr. Edward G. Blair.)

Degenerative changes are soon evident after the height of the reaction has been reached. Basophilic tints appear in the supporting tissues and in the walls of the vessels, which by this time are very edematous and thickened. The interstitial fluid seems to collect in large lymph spaces, and stretches the depleted walls of the lymph channels until they occupy prominent places, like large pools, in the microscopical picture. Regenerative changes on the part of the endothelial lining of the vessels produce an irregular thickening of the intima, which together with a thickening of the walls from the edema and degeneration of the elastic elements practically closes the lumen. Thrombosis is likely to ensue and to complete the obliteration. The marked basophilic degeneration of the connective tissue lasts a long time.

Regenerative attempts on the part of the injured tissue are feeble, probably due to the poor nourishment afforded by the occluded vessels. The epidermis, for the same reason, becomes thinned and atrophic (in the earlier stages it was thickened and hypertrophic). About the periphery of the injury, plasma cells may be seen, and fibroblasts begin to invade the destroyed zone, connective tissue proliferation becomes intense, and dense fibrous tissue is formed. At times the proliferation is very cellular and rapid, and again it may be abortive, indolent, and hyaline. The atrophic epidermis and degenerative connective tissue of the destroyed area, having no nourishment, may slough, leaving an ulceration with a fibrotic base and ischemic walls, and a necrotic surface, which is contaminated with saprophytic organisms. Attempts at repair are influenced by these factors.

Exposed nerve endings and irritation of the nerves in the floor of the ulcer cause severe pain. The epidermis at the edges of the ulcer reaches a hypertrophic state, with elongated rete pegs, in an effort to close the wound over abnormal supporting tissues, and in time the epithelial cells may become dyskeratotic. Complications may influence the future course of the *x*-ray or radium ulcer. Frequently the number of mitoses increases and the resulting cells grow succulent, with large nuclei containing increased chromatin. The mitoses form irregular figures, and there is some amitosis with resulting wild proliferation of incompletely cornified epithelium, which gives rise to squamous carcinoma.

In the inflammatory state the degenerative changes are especially pronounced about the skin appendages. The infiltration at that early time is marked about the pilosebaceous apparatus, probably because of the extreme vascularity of these structures. Later when degeneration has set in, the appendages atrophy rapidly, and in old *x*-ray skin they have completely disappeared so that there are no sweat or sebaceous glands or hair follicles.

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CHAPTER XII

DERMATOSES DUE TO LOCAL CHEMICAL IRRITANTS

NUMBERLESS substances of animal, vegetable, and mineral origin may cause an inflammation of the skin, or dermatitis. Although some strong chemicals will produce inflammation upon any skin, there may be an individual hypersusceptibility or idiosyncrasy to others which are harmless to most persons. In those who are susceptible the eruption may either become manifest soon after the first contact with the irritant or may not appear until after a long period of protracted exposure. One attack, however, seems to predispose the involved area so that subsequent outbreaks may be the result of very slight exposure.

Although all of these eruptions involute spontaneously upon identification and removal of the cause, some cases prove difficult because the identity of the irritant is not easily ascertained. Typical cases of dermatitis of external chemical origin with erythema, vesiculation, and linear lesions within scratch marks, occurring upon exposed parts, occasionally defy the skill of the dermatologist and require prolonged observation before isolation of the causative factor. In other instances as in painters, plasterers, and dentists, the cause of the dermatitis may be obvious, since in the pursuit of their work they are notably subject to such eruptions from turpentine, lime, and novocaine, but, a change of occupation being impossible, the course of the disease seems interminable. In further instances, severe types of impetigo, pustular folliculitis, and furunculosis are superimposed upon the original dermatitis; or the cutaneous reaction may provoke a hypersusceptibility to various other previously innocuous substances, which continue the inflammation indefinitely as eczema.

Most of the irritants naturally fall into certain groups which will be discussed separately under the headings of industrial dermatitis and dermatitis due to various dusts, hydrocarbons, drugs, and poisonous plants. A few which do not belong in these groups will be mentioned here.

Henna is incorporated in some *hair dyes* and *nail paints*, and causes eruptions that clinically resemble those described due to paraphenylendiamine. *Eyebrow pencils* that contain mascara or artificial coloring from coal tar products may produce a redness and swelling of the upper lids. *Inks* and *polishes* are sources of dermatitis. *Depilatories* and *shaving creams* containing barium sulphide or excessive amounts of alkali are common causes of skin eruptions. Among the *insecticides* roach powders and mosquito sprays deserve particular mention as frequently provoking dermatitis. Idiosyncrasy to *perfume* is occasionally encountered.

The gluteal region in infants is at times the site of an erythematous and papulovesicular dermatitis, described by Jacquet as *napkin-area dermatitis*. This eruption has been shown to be due to ammonia formed in the wet diaper *in situ* by the growth of a saprophytic bacillus, which splits the urinary urea into ammonia. Cooke has stated that this bacillus is derived from the intestinal contents and infests the diaper area as a result of soiling by feces.

Cases must be differentiated from local yeast infections by microscopical examination (see page 545).

Diapers dried, after impregnation, with an antiseptic such as mercuric chloride (1 : 4000) cause the prompt cessation of ammonia formation and a rapid involution of the skin lesions. For the treatment of napkin-area dermatitis of infants absolute cleanliness is necessary. Dry heat followed by generalized air-cooled ultraviolet irradiation in sub-erythema exposures given daily tends to increase the resistance of the skin. This is accompanied by the use of oils, followed by lotions if there is much exudation, and by powders when it is slight. The following prescriptions are useful:

℞.	Phenolis	gr. x
	Glycerini	℥iss
	Magnesii carbonatis	ʒiss
	Zinci oxidi	℥iij
	Ol. olivae	℥ij
	Aquae hamamelidis	q.s. ad. ℥viij

M. and S. Apply to affected areas every two hours after cleansing with olive oil.

℞.	Thymolis iodidi	ʒj
	Acidi borici	ʒss
	Zinci oleatis	ʒj
	Talci	q.s. ad. ℥iij

M. and place in shaker bottle. Sig. Antiseptic dusting powder.

The principal antiseptic action of this powder seems to be derived from the thymol.

In addition to thorough cleanliness, the avoidance of irritants and the protection of exposed parts are fundamental principles in the *treatment* of dermatitis of external chemical origin. Local remedies should be sedative, astringent wet dressings, lotions and pastes, depending upon the amount of exudation.

℞.	Liq. alumini acetatis	℥j
	Aquae camphorae	℥ij
	Glycerini	℥j
	Phenolis	ʒj
	Mentholis	gr. x
	Zinci oxidi	℥j
	Liq. calcis	q.s. ad. ℥viij

M. and S. Apply often enough to allay itching.

℞.	Zinci oxidi,	
	Cretae praeparatae,	
	Olei lini,	
	Liquoris calcis	āā ℥j

M. and S. Apply locally.

℞.	Zinci oxidi,	
	Amyli (rice),	
	Adipis lanae,	
	Petrolati albi	āā ℥j

M. and S. Apply locally.

℞.	Liq. alumini acetatis	ʒiij
	Petrolati liquidi	ʒj
	Adipis lanae	q.s. ad. ℥j

M. and S. Apply locally.

In recalcitrant cases where the cause is difficult to determine or avoid, ultraviolet radiation applied to the affected area has seemed to decrease the susceptibility of the skin and to diminish the pruritus and pustulation. Treatment should be given frequently with either the mercury or carbon arc lamp and in sufficient dosage to provoke tanning whenever possible. The spreading of the disease seems retarded and its duration reduced as a result of actinotherapy. We have applied ultraviolet light with apparent benefit to persistent cases of dye dermatitis and dermatitis in surgeons, dentists, nurses, barbers, bakers, painters, photographers, furriers, and laundresses. Russell has had similar experiences.

Roentgenotherapy is undoubtedly efficacious, hastening the involution of both subacute and chronic eruptions, relieving the pruritus and reducing the amount of secondary infection. It is particularly useful for the relief of sulphur dermatitis superimposed upon scabies. Accompanying lichenification is always favorably influenced.

Roentgen therapy is not curative and the relief afforded by it is usually temporary. In recurring cases it is important to impress upon the patient that roentgen treatment cannot be continued indefinitely, for there is a tendency for patients to become more or less dependent upon *x*-rays for relief. In these circumstances the danger of radiodermatitis is real, and after a few weeks of radiation such treatment should be discontinued for an interval in spite of the patient's protest. For some unknown reason cases which have long been resistant to other forms of therapy may occasionally be permanently cured by a few exposures to roentgen rays. The dosage in all instances should be fractional.

To summarize, treatment by either ultraviolet light or *x*-rays is beneficial in subacute or chronic cases of dermatitis venenata. Although the relief from actinotherapy is slow, it is generally the method of choice because roentgen therapy of recurring attacks of the disease is so liable to be persisted in for an unreasonably protracted period.

INDUSTRIAL DERMATITIS

Dermatitis due to irritants of a chemical nature encountered in industry forms a large part of dispensary practice, being given the terms "occupational dermatitis" and "trade eczema." The studies of the eczema problems in general are tending more and more to show that many unclassified cases are due to hypersusceptibility to external products, such as dyestuffs and furs. It has long been recognized that many plants cause skin eruptions, and the cutaneous effects of external contact of the skin with a plant, its appendages or sap, are called "dermatitis venenata" in this book, although this term is sometimes applied to the entire group of eruptions produced by external chemical irritants.

Through the industry and academic ability of R. Prosser White, our knowledge of occupational affections of the skin has been assembled into a scholarly volume, to which the author is indebted for much of the following material. The reaction of the skin to external chemical irritants is still, however, a matter of study. Some products are so powerful that they will cause an eruption on any skin, and many other products are harmless, except in isolated instances of unusual individual susceptibility. The susceptibility may be familial or acquired and varies at times in the same person. Certain conditions of the skin, such as ichthyosis and seborrhea, may predispose to it.

The immediate effect of contact may be the development of an erythematous, vesicular, or bullous dermatitis, or of a destructive burn. Such a reaction may apparently create a hypersusceptibility in the skin toward other previously innocuous substances, including parasitic micro-organisms, leading to the development of a more or less permanent eczematous eruption.

Prolonged contact with a vegetable or mineral substance may induce a state of hypersensitiveness of the skin, so that a patch of eczema is formed, and once this process is induced, the susceptibility is likely to be extended to many other substances, as previously stated, which may indefinitely prolong the eruption after contact with the original substance has ceased. Prolonged contact may cause other changes than eczema. The follicles are, by their structure, especially susceptible to chemical irritation; for which reason follicular, papular, and pustular eruptions are common forms of industrial dermatitis. Some products in particular cause epithelial hyperplasia and eventually lead to keratoses and carcinoma.

The most common injurious agent is *water,* which is irritating unless isotonic, a condition not found in nature. Distilled water is acid and tap water is usually alkaline due to the presence of salts. Distilled water, being hypotonic, desiccates the cells, and if it contains a sufficient quantity of an added soluble, though inert, salt, it becomes hypertonic, is irritating, and leads to edema. As the fluid evaporates from a salt solution it becomes stronger, and any tendency to injure that the basic or acid radicle possesses, is intensified. As pointed out by White, evaporation plays an important part in the effects of acids, alkalies, and salts upon the skin, for a harmless dilution, when subjected to evaporation caused by the heat of the body, soon becomes concentrated and injurious. So-called "hard waters" are always objectionable. It is totally impossible even to enumerate the irritants encountered in industry. Only the more important chemical agents will be mentioned.

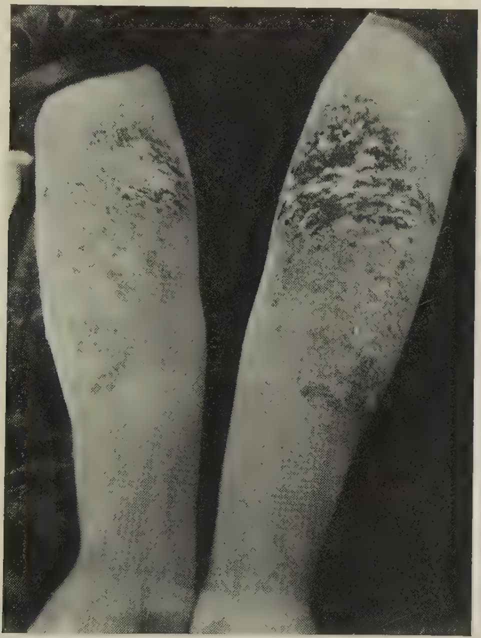

Fig. 156.—Dermatitis in a janitress due to shellac. (Courtesy of Dr. Samuel T. Millard.)

Dermatitis Due to Acids, Alkalies, and Some Metallic Salts.—The powerful acids are corrosive, whereas the weaker ones are astringents. *Hydrochloric acid* produces burns which are less deep and more liable to form blisters than injuries from sulphuric and nitric acids. Hydrochloric acid burns are encountered in those who handle or transport the product, and in plumbers and those who work in galvanizing or tin-plate factories. *Nitric acid* is a powerful oxidizing substance which causes deep burns, the parts becoming stained yellow. Such injuries are observed in those who manufacture or dispatch the acid or use it in the making of explosives in laboratories.

Sulphuric acid produces a brownish charring of the skin, beneath which is an ulceration that heals slowly. Sulphuric acid is used more widely than any other acid in industry, being handled principally by brass or iron workers or by those who work with copper or bronze. Other strong acids include *acetic, salicylic, hydrofluoric,* and *oxalic* acids, and also *phenol.*

Alkalies penetrate and destroy deeply because their compounds have a soluble action upon the tissues. Strong solutions are corrosive and the effects should be treated immediately by the application of weak acids. *Alkali itch* is a common form of occupational dermatitis produced by patent cleansers. Alkalies are also used by soap workers or those who handle greases or textiles. The principal compounds are sodium and potassium hydroxide, the alkaline sulphides—which are used as depilatories—the hypochlorites, and slaked and unslaked lime. Water-glass (sodium silicate) has caustic properties and is used chiefly in the manufacture of soap, in paper-sizing, and as a preservative for eggs.

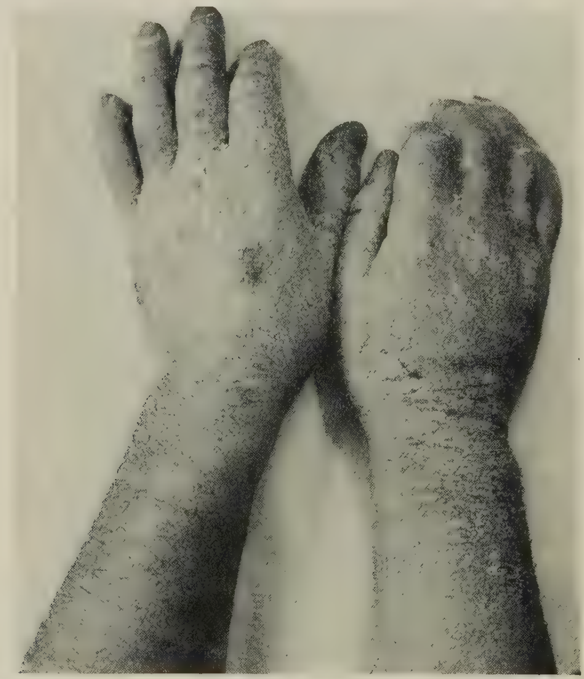

Fig. 157.—Dermatitis in a mason due to lime. (Courtesy of Dr. Elizabeth Laszlo.)

Metallic salts have an irritating and corrosive effect upon the skin, their action depending mainly upon their ease of dissociation. White considers the chlorides and the nitrites the most corrosive salts, and next the sulphites, sulphides, and sulphates. *Mercuric chloride* in weak solution (1 : 5000) is irritating, causing eruptions chiefly among surgeons, nurses, and taxidermists. *Fulminate of mercury* produces erythematous and papular eruptions, conjunctivitis, and swelling of the eyelids, in operatives. *Nitrate of mercury* produces irritation, eruptions being encountered among felt hat workers, and those who do etching, embossing, or art metal work. The manufacturing of thermometers, the handling of furs, the use of amalgams by dentists, the making of barometers, fire gilding, "constant potential" departments of electrical works, solder used for dry batteries are all common sources of contamination with mercury, which may cause various eczematous conditions.

Phosphorus may produce a dermatitis or burns. *Match box dermatitis* is a well-known example. Phosphorus is used chiefly in the manufacture of fireworks and rat paste.

Silver may cause a localized or diffuse bluish-black discoloration known as *argyria.* It occurs after long-continued medical use of silver nitrate or other silver compounds. Industrial cases have been reported among silversmiths and those who work with silver leaf and pearl beads.

A papular and pustular, follicular dermatitis may be caused by the salts of *antimony;* it is rarely encountered in industry.

Arsenic is one of the most common chemical causes of dermatitis, being observed in those who mine, extract, or refine copper, arsenic pyrites or other arsenical ores and in those who have contact with the artificial coloring of wallpaper, flowers, and chalk. Arsenical compounds are also used in dyeing fabrics and domestic articles, for the preservation of animal skins and hides, and for embalming. Arsenic is an ingredient of some disinfectants and weed exterminators, and is used in sheep-dip factories and in the making of fly-paper. It is encountered in submarine work, establishments where radio and automobile batteries are charged, in electroplating works, chemical factories for the manufacture of sulphuric and other acids, insecticide factories, and general chemical factories, printing establishments where gilt or bronze powder is used, in farming, and in gardening. Woolen goods which are sprayed with a solution of an arsenical compound are also a source. Among those who may incur this disease in the course of their occupation are glucose and candy factory workers, those who use sizing and dextrin, book-binders, fruit handlers, furriers who handle raw furs, machinists, and metal workers who handle brass, copper, and zinc. Excessive quantities of arsenic have been found frequently in gelatin, raw and canned fruits and vegetables, adulterated food coloring and confectionery, sea food, in baking powders, egg powders and self-raising flours, due to impure acid phosphate, and in cocoa and other chocolate products, in the manufacture of which potash is used. The present method of disposing of the boll weevil through the use of calcium arsenate puts arsenic in cotton.

Chromic acid and the *bichromates* are strongly corrosive, and irritative to the skin. Aside from occurrence among employees in chromate works, chrome dermatitis is encountered among tanners, painters, dyers, photographers, French polishers, photostat workers, and those concerned with the bleaching of crude oils, tallows, and fats. New employees are more liable to dermatitis than seasoned workers who have learned to protect themselves by careful attention to cleansing and avoidance of exposure. The skin changes are multiform, ranging from a mild follicular dermatitis to widespread nodular and crusted eruptions, all being worse upon exposed parts. The chrome hole or sore is a characteristic lesion which occurs upon the backs of the hands and forearms, usually beginning about a hair follicle, or in the creases of the knuckles, or in the finger-webs. The hole begins in a small abrasion which deepens and widens as its edges grow thick, eventually forming a conical indolent ulceration. Perforation of the nasal septum occurs occasionally in chromium workers.

Dermatitis Due to Various Dusts.—Many mineral, chemical, and vegetable dusts produce dermatoses and inflammations of the mucosae. These dusts are usually partially soluble in the skin secretions, and many of them contain moisture. Some of them undergo hydrolysis on the skin and thus become irritating. The finer the particles, the greater is the result due to increased chemical reaction. Subdivision assists the intimacy and enlarges the area of contact of dusts, and increases their solubility in the sweat, their deliquescence and temperature. The amount of moisture in the atmosphere and the heat of the workrooms are conditions which make even a normal person's skin damp and sticky, and powders are the more likely to adhere. A combination of mechanical and chemical irritation usually exists in dermatitis due to this cause. The dust sometimes clogs the pores, obstructing the outflow of sebum and sweat. Dust may contain *spores* which provoke a dermatitis by growing upon and invading the skin or by acting as an allergen. The skin manifestations tend to be present on exposed parts, especially the hands, face, and neck, but by saturation of the clothing may involve such apposed surfaces as the armpits and groins, which are rendered more susceptible by chafing.

Lime dust causes eruptions in plasterers or those who spread fertilizers. It is also observed in the smelting, bleaching, and dyeing trades. *Zinc* dust produces acneiform eruptions. Dust of *nickel* and *brass* and ores containing *arsenic* may produce a follicular dermatitis.

Silicate dust is encountered in scouring soap. Workers in silicate cotton are subject to a dermatitis from irritation by the spicules. Acetylene gas from *calcium carbide* in contact with moist skin forms caustic calcium hydrate, which produces a dermatitis and necrosis leading to punched-out holes. *Calcium cyanide* is a light powder which provokes a dermatitis or ulceration, and a peculiar systemic intoxication.[1] Dusts of high explosives occasionally produce a dermatitis which at first is erythematous, vesicular, and localized, but later becomes widespread and associated with the exfoliation of the epidermis. Hamilton believes that skin affections are most prevalent in *dinitrochlorbenzene* workers, next in decreasing ratio in *tetryl, T. N. T.*, and *picric acid* workers.

Picric acid is more active when the substance is in solution or in an ointment than in the form of a dust. Although picric acid dressings are generally harmless, occasional instances of extreme hypersusceptibility to the substance are encountered. A variety of war gases may cause eruptions.

The dusts of a large number of *woods* incite itching and dermatitis among persons working with them. Also some dry vegetable powders composed of minute grains and fibers, or containing spores and the mycelia of parasitic *fungi* may have similar effects. Dust from *cinchona bark, quinine, arnica, teak wood, pyrethrum,* or *Black Flag* produces widespread dermatitis. Many eruptions due to insect powders belong in this category. *Barley itch* is associated with an acute exudative follicular dermatitis caused by acari. *Tobacco* dust in cigar factories may also become a responsible factor. Powdered *orris root* and *lycopodium,* ingredients in face powder, may cause eruptions in sensitive persons.

Dermatitis Due to Various Hydrocarbons.—Many hydrocarbons produce skin eruptions. Raw *petroleum* causes generalized itching or folliculitis and acneiform eruptions. The latter are frequently pustular due to a predisposition of the inflamed follicles to invasion by cocci. *Lubricating oils* and *cutting emulsions* are causes of similar cutaneous lesions. When they are used over and over without filtering or sterilizing, the fine metal fragments cause minute abrasions in the skin, and infections by pyogenic micro-organisms are passed on from one worker to another through the medium of contaminated oil. The refined fractions from petroleum are less irritating than the unrefined products, although *benzine*, *naphtha*, and *carbon disulphide* may cause a mild dermatitis. Briquette makers develop dermatitis as a result of a tarry residue from petroleum used in their trade. Workers in *paraffin* show an irritation of the skin which leads to pustules, keratoses, and ulcerations. In *shale oil* workers there develops an erythematous, follicular eruption that eventually leads to keratoses which may become the site of carcinoma. White estimates that 50 per cent of shale oil workers suffer from skin troubles.

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[1] Koelsch, F.: Ueber neuartige gewerbliche Erkrankungen in Kalkstickstoffbetrieben, München. med. Wchnschr., 61: 1869, 1914.

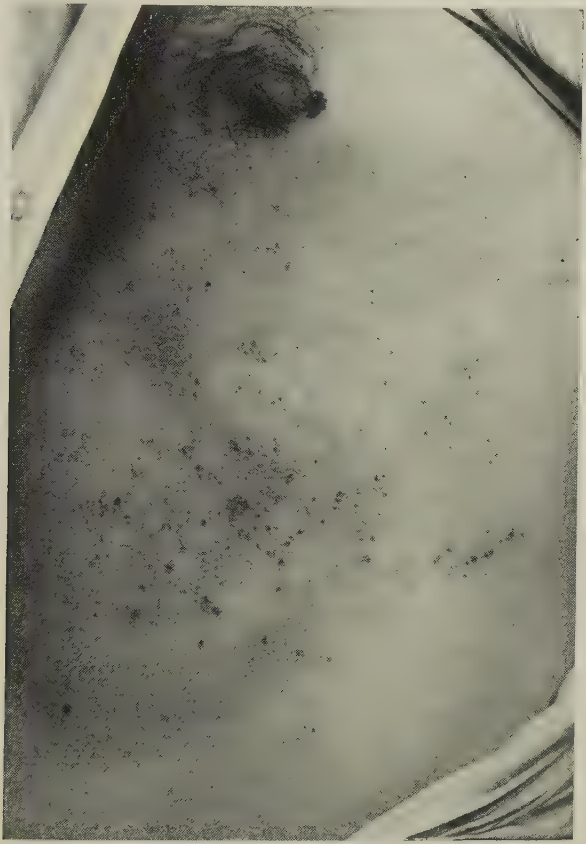

Fig. 158.—Dermatitis due to the action of matches carried in the vest pocket. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Impure and low-grade *paraffins* and *mineral oils* cause similar skin eruptions. The skin changes at first are black-capped projecting follicles that look like comedones, and hard, itching papules, usually on the forearms, later becoming acneiform with pustulation. In the course of time a more or less diffuse erythema and dappled pigmentation develop and there are some scars from involuted nodules. Gradually keratoses appear and after many years some of these are the sites of carcinoma. Melanoderma may occur from exposure to mineral oils and low-grade *vaselins*, from *creosote*, *asphalt* and other *tar* products. *Dermatitis vaselinica* is manifest clinically by a verrucous thickening of the skin, caused by prolonged contact with impure vaselin and, occasionally, lubricating oil. A follicular type occurs in which erythematous horny nodules are present, usually on the anterior and inner aspects of the thighs. There are no comedones and the lesions are separated by apparently normal skin. A third type, called *acne cornea*, consists of follicular keratosis and pigmentation and was described by Oppenheim as an occupational dermatitis due to tar, unrefined tar oils, and paraffin. It involves chiefly the dorsal aspects of the fingers and hands, the arms, the legs, the face, and the thorax. The subjects are usually railroad workers—engineers, mechanics,

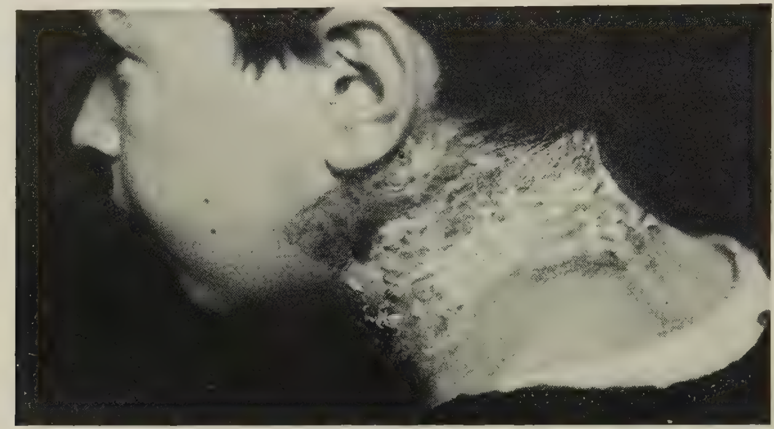

Fig. 159.—Dermatitis due to combined application of tincture of iodine and ammoniated mercury ointment. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

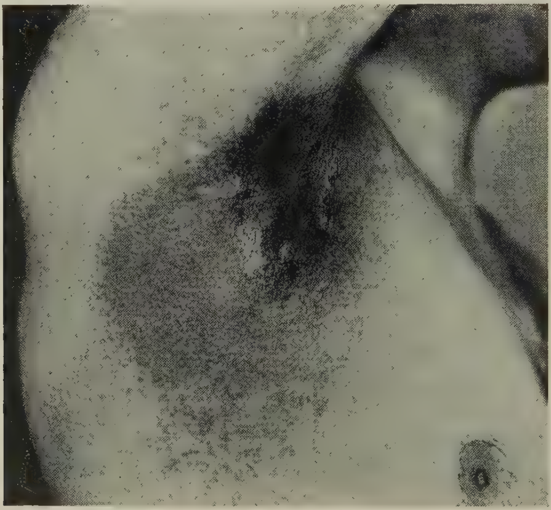

Fig. 160.—Dermatitis due to the application of blue ointment.

and stokers. The lesions are follicular, horny papules, often black, and are associated at first with a follicular erythema and later with a dirty brownish or purplish spotty pigmentation, which in severe cases becomes widespread, being especially marked about the genitals. This syndrome may simulate pityriasis rubra pilaris or lichen spinulosus.

Mule spinners' cancer has been an important study in the cotton industry in England; only a few cases have been reported in this country. Low-grade oils used for the lubrication of the machine produce inflammatory and warty changes in the skin of the scrotum, which part is chiefly subjected to irritation. Neglect of personal cleanliness strongly predisposes to this complaint. On account of the construction of the machine, the oil collects, together with dirt, in the folds of the skin of the scrotum. Scrotal cancer is a very rare disease, but in this occupation it is estimated by Southam[1] to affect 2½ per cent of the 25,000 adult male employees, the average length of employment being forty years. In 83½ per cent of affected persons, the cancer occurs upon the scrotum and in 16½ per cent on other parts of the body.[2] Leitch and Kennaway and others have experimentally produced *paraffin* and *tar cancer* in mice. In man it occurs principally in employees of gas works. *Coal tar* and *pitch* and many of their derivatives produce occupational dermatoses, specifically stimulating epithelial proliferation. *Naphthalene, creosote, anthracene* and related products are responsible for skin eruptions. Anthracene oils and *acridin* are used as rubber substitutes in some telephone- and radio-receivers and have been the cause of dermatitis of the ears.[3] In the manufacture of *chlorine* the workers develop an acneiform dermatitis and a folliculitis (chlor-acne) with small black plugs and papules chiefly on the face and apparently due to chlorinated naphthalene.[4]

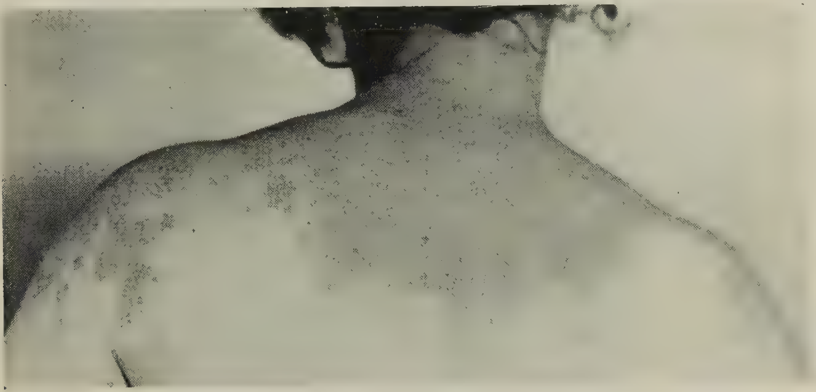

Fig. 161.—Dermatitis due to fur collar. (Courtesy of Dr. Victor Lopez.)

Tar melanosis is a diffuse, mottled brownish pigmentation of the skin due to heated tar, which has been previously described. Tar and pitch produce an acneiform folliculitis of the forearms, legs, face, and scrotum with follicular keratoses, which may later change into cancer.

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[1] Southam, A. H.: Mule Spinners' Cancer, Clinical Features and Treatment, Brit. M. J., 1: 366–367, Feb. 26, 1927.

[2] Robertson, J.: Mule Spinners' Cancer, Brit. M. J., 2: 1181–1182, Dec. 18, 1926.

[3] Stein, R. O.: Ueber das klinische Bild, die Ursache und die Verhutung der durch Telephon- und Radiohörer erzeugten Hautentzundung, Wien. klin. Wchnschr., 38: 239, 1925.

[4] Thibierge, G., and Pagniez, P.: L'Acné chlorique, Ann. de dermat. et syph., 1: 822–824, July, 1900.

Dermatitis may arise in those engaged in the manufacture and use of synthetic dyes, chiefly *paraphenylenediamine,* which is employed universally for hair and fur dyes, being known as *ursal* in this industry. Irritation of the skin from the paraphenylenediamine dyes is usually due to its oxidation product, *quinone,* which substance, when moistened with water and applied to the skin, acts as a powerful irritant. A solution of sodium hyposulphite has a neutralizing action, and effectively relieves the pruritus. Most patients who have paraphenylenediamine dermatitis give positive skin reactions to patch tests with a 10 per cent alcoholic solution of this chemical product applied upon an unaffected area over night.

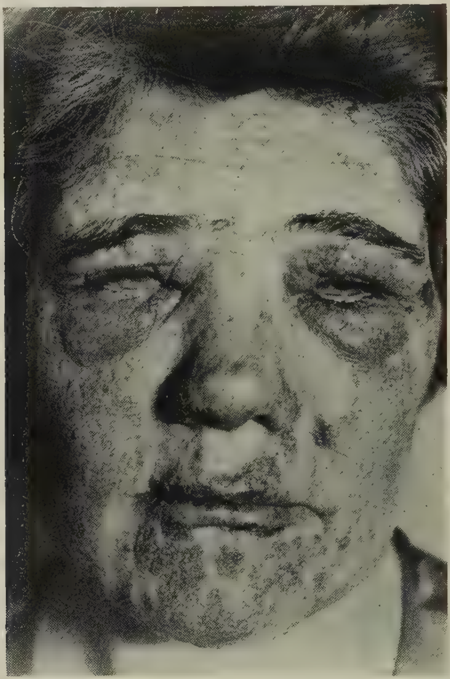

Fig. 162.—Dermatitis due to hair dye (paraphenylenediamine).

Distribution is an important diagnostic feature of dye dermatitis. The eruptions due to *hair dyes* usually begin with itching, redness, and puffiness of the upper eyelids, tops of the ears, sides of the forehead, and back of neck, being most pronounced about the follicles. Rapidly the areas become lichenified or scaly, the eruption spreading to other parts, especially the bends of the elbows. I had one case of intense brawny edema of the scalp, forehead, and eyelids, without redness or heat, so that the appearance of the head suggested hydrocephalus. After lasting a week, it completely disappeared. The distribution of dye dermatitis due to *fur collars* and *cuffs* is at first under the chin, on the front of the neck,[1] in a more or less triangular area over the sternum, and on the wrists. Another case due to the home dyeing of a *dress* involved the arms, shoulders, and a sharply limited area on each knee, extending from the middle of the thigh at the lower edge of the bloomers to the upper part of the calf at the end of the rolled stockings. *Hairdressers* and *furriers* develop eruptions at first on the backs of the hands, the front of the wrists, the forearms, eyelids, nose, and forehead and other parts of the face. Aniline compounds employed in the coloring of lipsticks, rouges, hatbands, artificial flowers, and various articles of apparel may cause dermatitis. An eruption on the hands and wrists may follow the use of *tintex*. *Metol* is a source of similar dermatitis in photographers.

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[1] White, R. Prosser: The Causes of Fur Dermatitis, J. State Med., 32: 16–24, Jan., 1924.

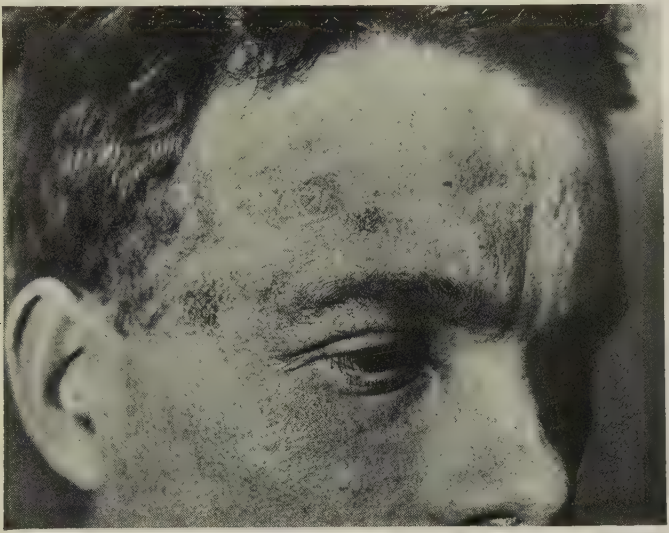

Fig. 163.—Hatband dermatitis. (Courtesy of Dr. Paul Gross.)

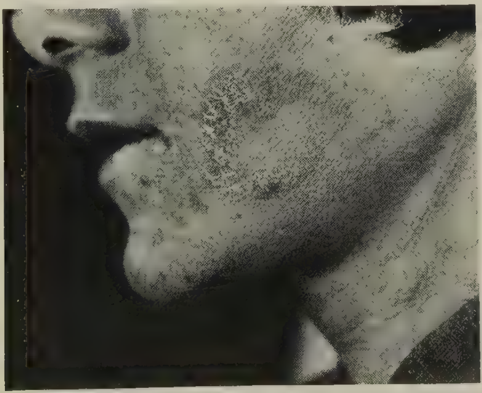

Fig. 164.—Lipstick dermatitis. Note heart shape due to painting a heart on the cheek with a lipstick.

Soot, lamp black, and *peat* produce dermatitis of a dry, scaly character which in the course of time forms warty outgrowths and cancer. *Chimney-sweep's cancer* was first described by Pott in 1790. The cancer occurs upon a soot wart and is usually located upon the scrotum where the soot, sebum, and dirt collect in the folds of the skin. This form of cancer is much less prevalent than formerly, due partly to greater cleanliness in trade methods. It is unknown outside of England.

Industries Commonly Affected.—Workers in various trades are prone to skin eruptions and many cases under the Workmen's Compensation Act are in this connection. The following are of such common occurrence that they deserve special mention:

Autotypers	due to bichromate.
Bakers	due to flour or sugar, possibly related to the arsenic content, also to cotton seed oil and potash; the former being used in bread, the latter, in pretzels.
Barbers	due to quinine, resorcin, mercury, and sulphur in hair tonics.
Bronzers	due to arsenic.
Burnishers	due to mercury.
Chemists	due to many irritants handled by them.
Compositors	due to benzine or bichromate.
Cooks	due to patent cleaners, strong soap, kitchen insecticides.
Dentists	due to novocaine.
Electroplaters	due to cyanide and various acids.
Electrotypers	from copper sulphate and hydrochloric acid.
Exterminators	due to action of arsenic, formalin, sodium chloride or pyrethrum.
Foresters	due to poisonous shrubs and sprays.
Furriers	due to arsenic and paraphenylenediamine.
Gardners	due to plants, arsenic, insecticides, lime dust, and fertilizers.
Grocers	due to handling of sugar and flour.
Interior decorators	due to artificial coloring in fabrics.
Jewelers	due to cyanide.
Milliners	due to dyes and arsenic.
Munition workers	from various explosives.
Nurses	from bichloride, formalin, medicated alcohol, lye or other antiseptics used in scrubbing up.
Painters	from turpentine, varnish remover, arsenic, linseed oil, and aniline dyes.
Photostatic operators	due to chromates.
Photographers	from pyrogallol, metol or caustic soda.
Piano-workers	due to aniline dyes and arsenic in felt.
Polishers of metal	due to oxalic acid, turpentine, and bichromate.
Photogravure workers	due to paranitralin red.
Printers	due to arsenic, artificial coloring and hydrocarbons in inks.
Soap workers	due to strong alkalies.
Surgeons	from antiseptics used in scrubbing up.
Tanners	from bichromate and hydrochloric acid.
Washerwomen	due to patent cleaners, strong soaps, and roach powders.

SOME IRRITATING DRUGS

Eruptions may be caused by many drugs used in local applications. Some of these are:

Butesin picrate occasionally produces a severe exudative dermatitis.

Butyn is a cause of dermatitis.

Formalin dermatitis is encountered among laboratory workers and undertakers.

Iodoform, especially when applied as an impregnated gauze packed into a cavity, is likely to produce a dermatitis.

Lead rarely produces a dermatitis.

Mercury, especially in ointments, may produce various grades of dermatitis.

Orthoform will produce papular and vesicular eruptions.

Sulphur is a frequent cause of dermatitis.

Salicylic acid produces whitening and exfoliation of the epidermis, and an erythematous dermatitis with vesiculation.

Pyrogallol is a cause of eruption.

Resorcin is a frequent cause of dermatitis from hair lotions and ointments.

DERMATITIS VENENATA

Dermatitis venenata, or plant poisoning, is due to a hypersensitiveness, which is usually inborn, but may be passively transmitted or otherwise acquired. The eruptions are, as a rule, vesicular and accompanied by marked edema, although occasionally purely erythematous eruptions or discrete bullae are observed. The onset is sudden, a few hours or days after exposure, with involvement of the face, neck, wrists, and hands. There is a tendency for the dermatitis to spread by auto-inoculation, especially in scratch marks, so that linear lesions are produced.

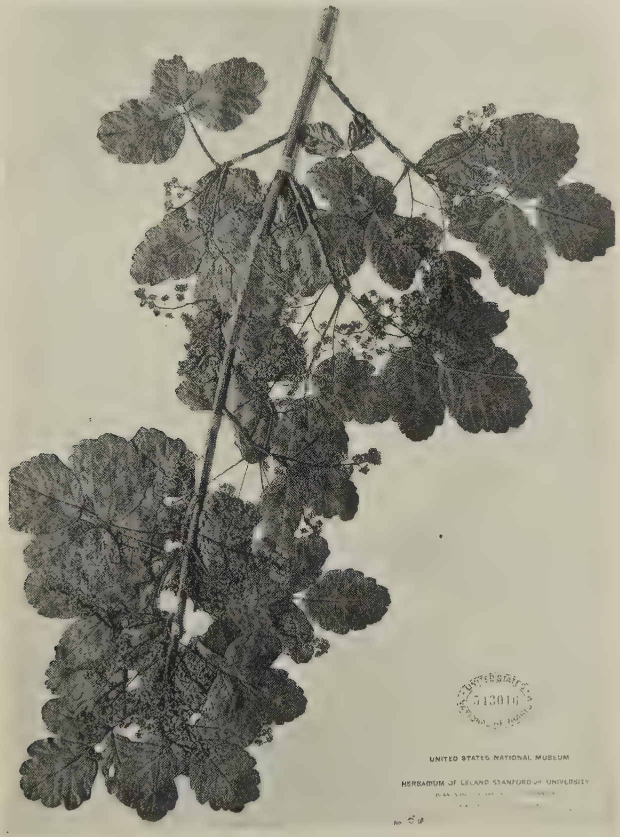
UNITED STATES NATIONAL MUSEUM
HERBARIUM OF LELAND STANFORD JR. UNIVERSITY

Fig. 165.—Poison oak of the Pacific Coast. Portion of the branch in flower. (Courtesy of United States National Herbarium.)

Primrose dermatitis usually begins on the index finger and thumb of the right hand, and on the eyelids or front of the neck as a punctate or diffuse erythema, which may spread to other parts and become edematous, papular, or scaly. Bloch painted the skin of persons who were not idiosyncratic with concentrated extract of primula, an area on the arm being first abraded with sandpaper. A vesicular inflammation appeared at the site of the application and thereafter the subjects were hypersensitive to contact with the primrose. He believes that the reaction is thus caused by the formation and cooperation of genuine specific antibodies.

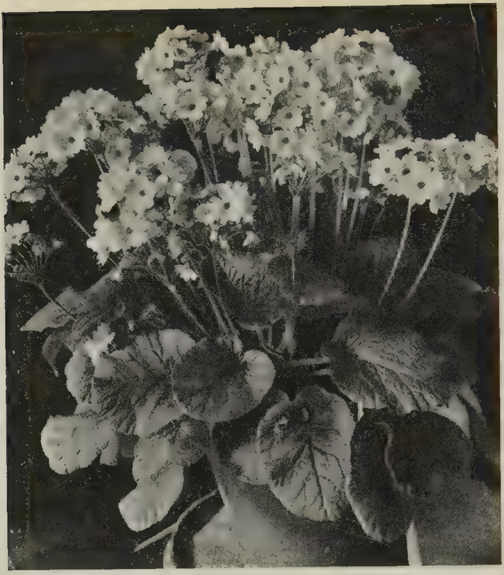

Fig. 166.—Primrose plant in flower.

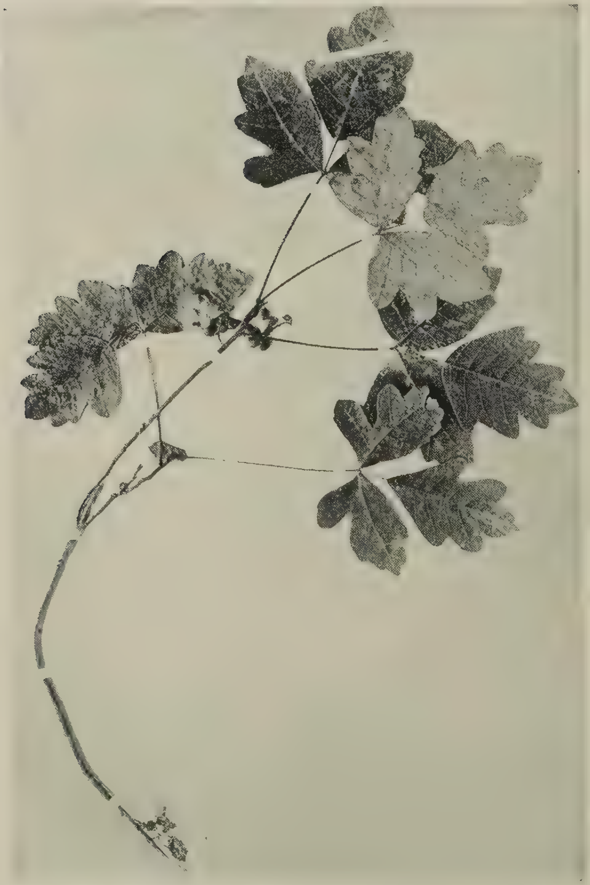

Fig. 167.—Oak-leaf poison ivy of the Eastern United States. (Courtesy of United States Department of Agriculture.)

"Poison ivy" or rhus dermatitis is common in this country; it is probably caused by a volatile oil or glucoside. It usually begins upon the backs of the fingers, the interdigits, the wrists, and eyelids, although it may begin upon the ankles, or other parts which have been exposed through thin clothing. The lesions are vesicular, usually grouped, and often linear. The eyelids are puffy, being worse in the morning, and better in the afternoon, when the swelling is dissipated by the movement of the facial muscles. The dermatitis is transmitted by the fingers to other parts, especially the forearms, and the male genitals, which become greatly swollen. Some persons are so susceptible that direct contact is not necessary, the poison being apparently carried a short distance by the wind. Repeated attacks do not confer any lasting immunity.

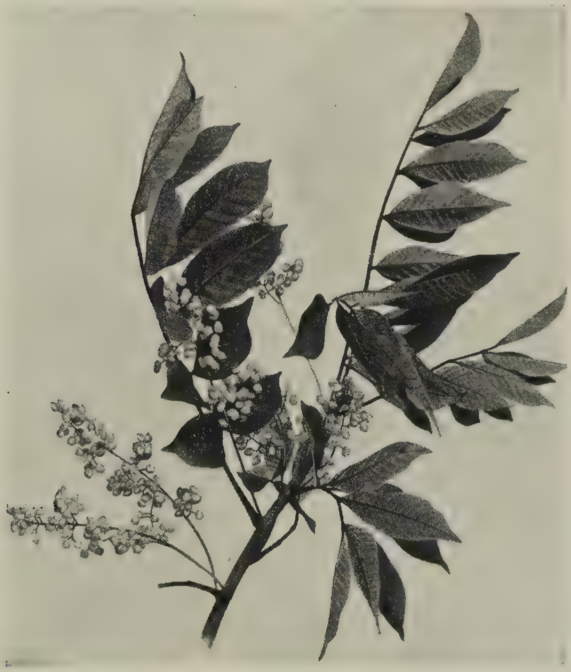

Fig. 168.—Poison sumac. (From a water color by F. A. Walpole, courtesy of United States Department of Agriculture.)

Lacquer dermatitis occurs principally in the Orient where the lacquer tree is indigenous, but is encountered elsewhere due to lacquered products, although the toxicity is lessened by aging, oxidization, and dryness.

Poison sumac, dogwood, and *ash* are shrubs which grow in swampy places in this country and Canada. The eruptions produced by these shrubs resemble poison ivy dermatitis, but have a tendency, however, to be more erythematous and less vesicular, and to occur later in the summer. *Poison oak* grows principally in the western states. It is a member of the rhus family and is a frequent cause of a dermatitis similar to that produced by poison ivy.

Treatment.—The treatment of dermatitis venenata is both external and internal, the latter having dubious value. Persons of known susceptibility should not only avoid touching the plants, but, in addition, should exert care in handling articles of clothing, tools, playthings, and pets which have been in contact with them. Plants occurring in frequented places should be eradicated by spraying with a strong solution of common salt in soapy water, or with kerosene. After exposure, the poison is on the surface of the skin and may be removed by thorough washing and rinsing, repeated several times. Ordinary kitchen soap which is strongly alkaline is best for this purpose. The hands, particularly the fingernails, should receive special attention, as also should the webs between the fingers. In the early cases or immediately after exposure, the disease may be controlled or prevented by a thorough scrubbing of the parts with benzine followed by rinsing with alcohol. After the disease has been manifest for a day or two, these measures are useless and reliance must be placed upon soothing astringent preparations. These are manifold. The most popular is carbolated and mentholated calamine lotion:

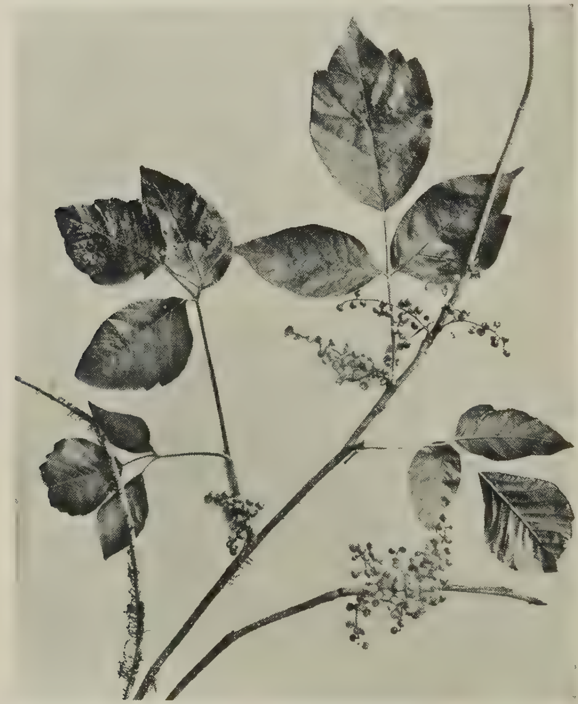

Fig. 169.—Poison ivy, branches showing the leaves, fruit, and aerial rootlets. (Courtesy of United States Department of Agriculture.)

℞.	Phenol	ʒj
	Menthol	gr. x
	Calamine prep.,	
	Zinc oxide,	
	Glycerin	āā ℥ij
	Alcohol	ʒj
	Witch hazel	q.s. ad. ℥viij

Apply locally often enough to stop itching.

Mild itching may be relieved by this lotion, but when the itching occurs in intense spasms, it is best controlled by the application of cloths wrung out in ice water. At times the parts involved are brawny and tense, due to edema; this condition is best handled by cold wet dressings of liquor plumbi subacetatis or liquor alumini acetatis, diluted 1 to 20 parts by water. McNair, in 1925, recommended the use of ferric chloride solution in the treatment of poison ivy. A 5 per cent aqueous solution has seemed to prevent spreading and in spite of its staining qualities has become a popular and apparently effective remedy among my patients. This solution is most beneficial if applied before possible exposure to poison ivy or immediately after actual contact with it. When the genitals are affected, wet dressings of olive oil, 10 per cent emulsified with tragacanth in lime water, are soothing. A 1 per cent solution of phenol may be added. Cotton is soaked in this mixture and swathed about the parts, which, in addition, are protected from friction against the clothes by the use of a Japanese suspensory[1] lined with a sheet of oiled silk.

A 5 per cent solution of potassium permanganate sponged upon the affected areas is recommended. The brown stain caused by this application will gradually wash off or may be removed by the use of lemon juice or of a 1 per cent solution of sodium bisulphite. One or two heaping teaspoonfuls of sodium bicarbonate or of magnesium sulphate to a cup of water are common remedies. Fluid extract of grindelia, diluted with 5 to 10 parts of water, is beneficial. These solutions should be applied loosely on gauze, which should be kept moist and should also be changed and discarded frequently in order to avoid infection. During the exudative stages ointments or remedies containing fats or oils should not be used, as they tend to dissolve and spread the poison; but at a later time, when the toxic substance has become dissipated, unguentum zinci oxidi or pasta zinci mollis (U. S. P.) expedites healing.

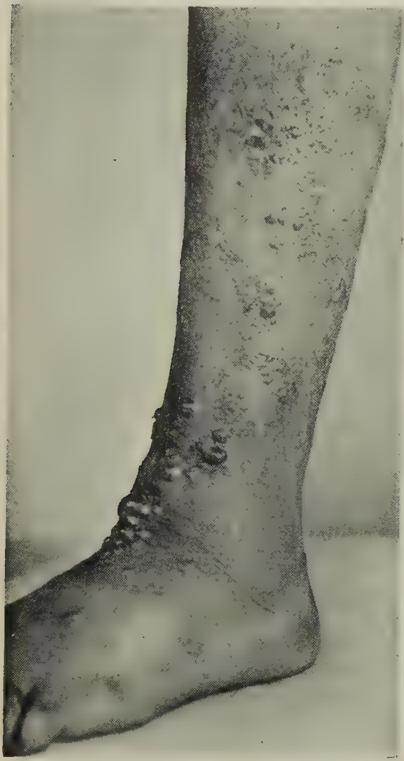

Fig. 170.—Dermatitis venenata (poison ivy).

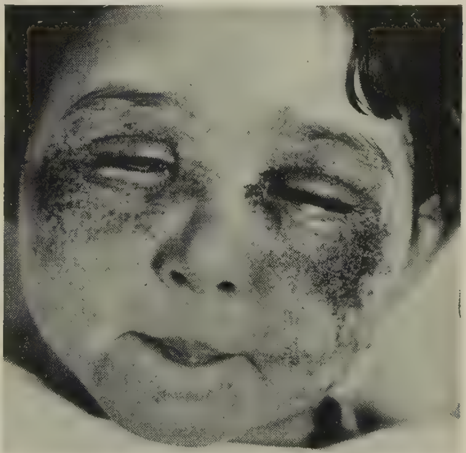

Fig. 171.—Characteristic swelling of the lids in poison ivy dermatitis.

Innumerable attempts have been made to immunize against dermatitis due to poison ivy, by ingestion of the leaves, oral administration of the tincture, and by hypodermic injections of toxic extracts. None of these measures has definite value, either as a preventive or as a cure; and sometimes they seem to have a detrimental effect. Although this is usually manifested only by increased severity of the eruption, the action may be systemic. Templeton has reported several untoward reactions from injections of extracts of poison oak. One of my patients who had a marked idiosyncrasy and was forced eventually to leave college on account of the prevalence of poison ivy on the grounds, was made seriously ill by the customary drop doses of tincture of Rhus toxicodendron, lying in a comatose condition for twelve hours before she could be aroused. As the patient never had epilepsy or similar attacks before or since that time, the etiologic relationship to the rhus toxin seems highly probable. In our present state of knowledge desensitization should be attempted only by very small and gradually increasing doses.

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[1] These can be obtained from the Sanitos Fundosa Co., Cleveland, Ohio.

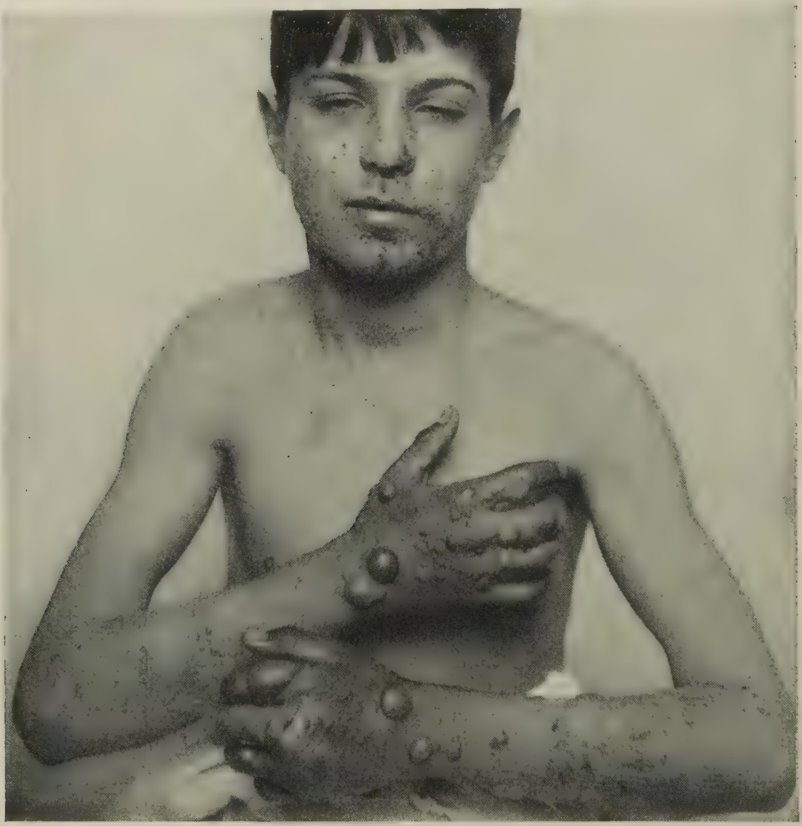

Fig. 172.—Dermatitis venenata (poison ivy). (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Numberless other plants are poisonous. The appended list of the more common ones in this country has been supplied by the United States Department of Agriculture.

Lady's-slippers are provided with glandular hairs which cover the surface of the stem and leaves and contain a poisonous oil, which is especially abundant at the fruiting season. Its action on the skin is similar to poison ivy.

Poinsettia, a cultivated variety of the spurge family, is one of its best known members.

All species contain a milky juice, which is more or less acrid and irritating to the skin and others have stinging hairs. Gardeners are sometimes poisoned while trimming the cultivated varieties. When applied to the skin the juice causes redness, itching, and even bullae. The effects are much like those encountered in rhus poisoning, for which it is sometimes mistaken.

Poison ivy, poison oak, and poison sumac are popularly recognized as *the* poisonous plants of America. The effects are familiar to everyone and victims outnumber by far those of all other plants. The clinical features of the dermatitis have already been described.

Systemic poisoning is caused by many of the gill fungi, popularly known as toadstools and mushrooms; by false hellebore, a member of the bunch-flower family; by the lily-of-the-valley family; by the lady's-slippers of the orchid family; by the corn cockle of the pink family; by aconite and larkspurs of the crowfoot family; by black cherry of the plum family; by the Kentucky coffee tree of the senna family; by woolly loco weed, stemless loco weed, and rattle box of the pea family; by members of the spurge family and the buckeye family; by water hemlock and poison hemlock of the carrot family; by some of the laurels of the heath family; by false jessamine (logania family); jimson weeds, nightshades, bittersweet (potato family); and sneezeweed (sunflower family).

Sequeira states that the following plants in addition have caused dermatitis: Asparagus officinalis, Balm of Gilead, Bell-heather, Bitter orange, Burdock, Buttercup, Chrysanthemum, Colchicum, Cotoneaster microphylla, Cowhage, Cow-parsnip, Cucumber, Daffodil, Daphne mezereum, Eucalyptus hemiphloia, Euphorbiaceae, Fig, Fox-glove, Geranium, Hops, Humea elegans, Indian Bean, Indian Turnip, Larkspur, Leopard's Bane, Lilac, Mayweed, Millfoil, Nettle, Oleander, Parsnip, Rue, Skunk cabbage, Smartweed or Water-pepper, Squill, Thrapsia, Tomato leaves, and Vanilla.

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CHAPTER XIII

DERMATITIS MEDICAMENTOSA

Synonym.—Drug eruptions.

Eruptions produced by the consumption and injection of drugs and their internal action are included under the term "dermatitis medicamentosa." This group of skin affections is considered separately from those eruptions produced by external applications of chemical irritants, for example, formalin dermatitis and iodoform dermatitis, to which the term "dermatitis venenata" is sometimes applied.

There are over two hundred drugs in common use which are liable upon consumption to produce skin eruptions. They cause practically every type of lesion and the same drug may give rise to different manifestations in the same individual; consequently the skin lesions may be uniform or multiform, although the former is the more common. Drugs unrelated chemically may produce similar lesions, or when combined with other drugs the skin manifestations may be altered. For instance, urticaria may be produced by iodides, bromides, any of the analgesic or hypnotic coal tar products, phenolphthalein, arsenic, quinine, jaborandi, copaiba, tolu, *et cetera;* whereas the iodides may also cause papules, pustules, bullous lesions, nodules, petechiae, or fungating growths. The skin manifestations may be widespread, or limited to certain areas such as the face, wrists, or lower legs, and are often symmetrically distributed.

The eruptions produced by drugs, while not sufficiently characteristic to indicate the causative agent exactly, are usually distinctive enough to suggest a medicinal cause. The diagnosis is established by careful questioning and, when necessary, by testing the patient's sensitiveness to the drug by giving a dose of it which will cause an exacerbation of the skin lesions if it has an etiologic relation.

The skin manifestations may result from a single small dose in hypersusceptible persons, but more often the effect is from a gradual accumulation which exceeds the threshold of tolerance that exists in all persons with individual variations. Not infrequently, there seems to be a state of hypersensitiveness created by intermittent doses, so that a small dose followed by a long free interval and a repetition of the dose produces a skin eruption which did not occur after the first administration. When the eruption appears after a single dose there may be an interval of several hours between the ingestion of the drug and the cutaneous manifestations, the interval being short in those who are highly susceptible. Erythematous eruptions usually appear sooner than the other types. At times, in addition to the skin eruption, there are general symptoms of intoxication from the drug, such as nausea, cramps, diarrhea, pains in the extremities, tinnitus, rhinitis, pharyngitis, hyperpyrexia, *et cetera.*

After the drug is discontinued, the skin lesions tend to disappear and, with a few exceptions, are entirely gone in the course of a couple of weeks. The granulomatous formations produced by bromides and iodides are slow to involute and may persist for months, but eventually disappear. Hyperkeratosis and pigmentation due to arsenic last indefinitely and have a tendency to become more severe in the course of time. Arsenical eruptions may not appear for years after the administration of arsenic has been stopped. The persistent and pigmented erythema ("fixed eruption") due to phenolphthalein and sometimes to salvarsan may last for a long time after cessation of the drug.

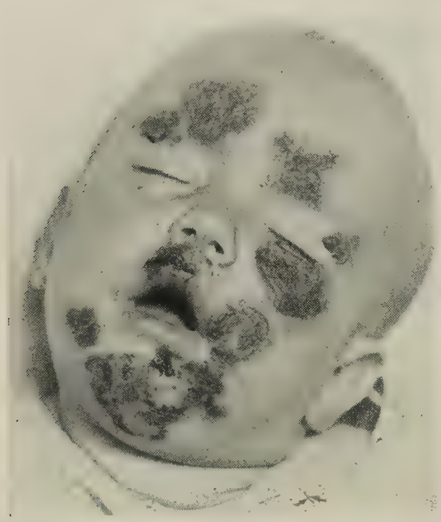

Fig. 173.—Bromide eruption in nursing baby whose mother was taking bromides. (Courtesy of Dr. H. A. Dixon, Toronto, Ont.)

Drug eruptions are distinguished from other skin conditions, which they may simulate, by their sudden appearance; by atypical distribution, usually symmetrical and widespread; by a brighter color, and by the comparatively extensive skin lesions, with little systemic disturbance. Thus the course of the drug eruption does not follow that of any of the exanthemata. There are generally also the history of the taking of the drug and an improvement of the skin lesions when its administration is stopped.

Manifestations of Different Drugs.—Whereas it is totally impossible to give a complete list of the eruptions produced by drugs, certain manifestations are well known and will be of assistance in diagnosis. The drugs which produce *erythematous* eruptions are innumerable. Macular, erythematous

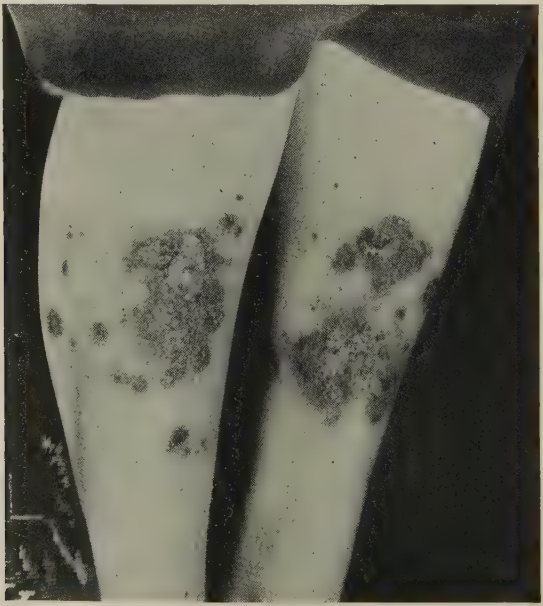

Fig. 174.—Bromide eruption resembling tertiary syphilis. (Courtesy of Dr. Samuel T. Millard.)

eruptions are usually widespread with involvement of the trunk, arms, and face, being at times morbilliform or scarlatiniform. When due to animal serum, they begin five to ten days after the injection and are accompanied by general adenopathy, fever, malaise, and pains in the extremities. Antipyrine, phenacetin, the salicylates, and other coal tar derivatives with analgesic, antipyretic, and antirheumatic properties, produce macular eruptions. These are likely to be extensively distributed over the trunk and extremities. Quinine, copaiba, cubebs, tolu, belladonna, morphine, and opium produce similar blotchy macular eruptions. The coal tar hypnotics (allonal, veronal, luminal, sulphonal, *et cetera*) produce erythematous eruptions of all types. Arsenic, bromides, iodides, phenolphthalein, chloral or turpentine also cause such skin manifestations. To the drugs already enumerated there might be added many others which are in less common use.

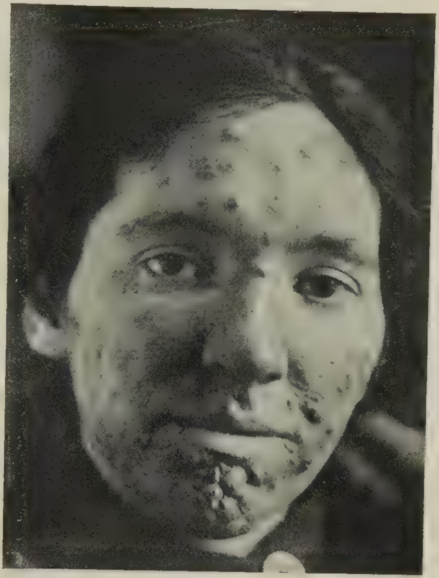
Fig. 175.—Acneiform eruption due to bromide. (Courtesy of Dr. N. T. Beers.)

Urticarial eruptions may be produced by the same drugs that produce erythematous eruptions. Urticaria is especially common in drug eruptions produced by animal sera. arsenic, iodides and bromides, quinine, phenacetin, atophan, and phenolphthalein. These drugs are also common causes of eruptions of the erythema multiforme type.

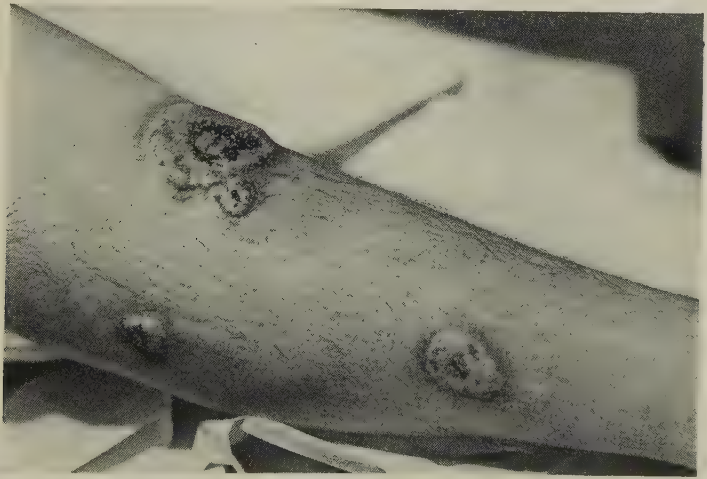
Fig. 176.—Granulomatous lesions caused by bromide. (Courtesy of Dr. J. Gardner Hopkins.)

Vesicular eruptions are caused by arsenic, bromides, iodides, quinine, antipyrine, antimony, chloral, sodium thiosulphate, *et cetera.* Herpes zoster and herpes simplex are produced by arsenic, run their usual course, and disappear even though the arsenic administration is continued.

Bullous eruptions are produced by iodides, quinine, antipyrine, phenolphthalein, luminal, the salicylates, the bromides, and chloral, being especially common when the last two are mixed together.

Pustular eruptions are produced by bromides and iodides, antimony, antipyrine, arsenic, chloral, salicylates, and turpentine. These are most commonly acneiform (bromides, iodides, chloral), but may be vegetating granulomas (bromides and iodides), or ulcerations with gangrene (arsenic, chloral, bromides, iodides, and quinine).

Hemorrhagic lesions occur with the formation of ecchymoses or purpuric spots following the use of several drugs, copaiba, ergot, bromides and iodides, quinine, antipyrine, salicylates, sulphonal, and often by animal serum. *Keratotic* lesions and *pigmentary* changes are both produced by arsenic, whereas pigmentation is also caused by the silver salts, particularly silver nitrate, argyrol, and silver arsphenamine; and by bismuth.

Eruptions Produced by Common Drugs.—It is impractical to give a complete list, but those drugs in common use will be mentioned.

Acetanilid may produce a widespread, blotchy, erythematous eruption. Large doses cause cyanosis.

Aconite may cause erythematous or vesicular eruptions.

Adalin is liable to cause erythematous, macular, or urticarial eruptions.

Antimony rarely produces an erythematous or urticarial eruption.

Antipyrine frequently produces skin eruptions which are usually of the erythematous type, being often morbilliform or scarlatiniform. Urticarial, vesicular, pustular, and bullous lesions have been reported and they have sometimes been located upon the mucous membranes. The eruptions may be followed by desquamation and pigmentation.

Antitoxin eruptions are caused chiefly by a sensitization to animal serum (see page 335).

Arsenic, although given less often than formerly, still frequently causes skin eruptions. These may be acute intoxications due to hypersensitiveness and occurring after a few doses, or they may be the result of long-continued action by the drug upon the epithelium. The former are widespread, erythematous, vesicular, bullous, papular, or pustular eruptions, or even an extensive generalized exfoliative dermatitis, accompanied by constitutional symptoms such as abdominal pain, diarrhea, pains in the extremities, fever and edema, especially of the fingers, eyelids, and feet. The slow action of long-continued administration may not be manifest clinically for a decade or more after the drug has been stopped. The late lesions are due to epithelial hyperplasia with the formation of keratoses, chiefly on the palms and soles, upon which carcinoma frequently develops. The keratosis occurs in discrete, warty lesions or in a diffuse form and has follicular tendencies, being especially prominent around the sweat pores. The keratosis is distinctive, usually being symmetrical and surmounted by small black, shiny pegs of keratin which, when picked out, leave pits. Arsenic is present in the keratoses, being distributed between the cells of the horny layer and also in the corium of the normal skin surrounding the keratoses.[1] Fissures frequently are observed and may likewise be the site of carcinoma. A follicular keratosis resembling keratosis pilaris may occur in a widespread manner, being especially pronounced over the chest where it may also cause a marked keratosis of the nipples, and on the back.

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[1] Osborne, E. D.: Microchemical Studies of Arsenic in Arsenical Pigmentation and Keratoses, Arch. Dermat. and Syph., 12: 773–788, Dec., 1925.

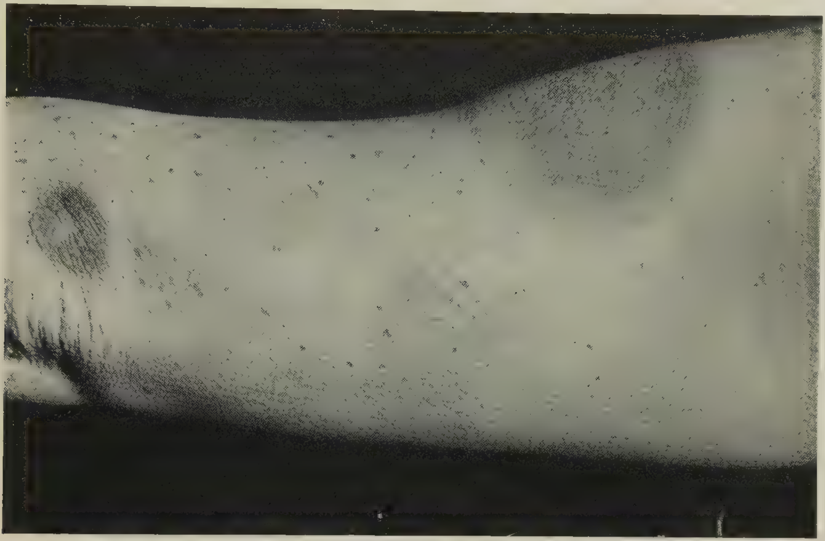

Fig. 177.—Fixed eruption from pyramidon. (Courtesy of Dr. E. William Abramowitz.)

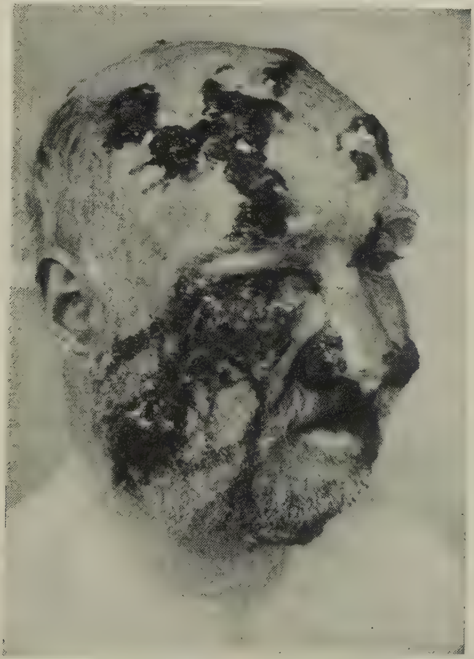

Fig. 178.—Fungating iodide eruption. (Courtesy of Dr. Morris Shapiro.)

Arsenical carcinoma, as stated, develops on keratoses or fissures in areas of arsenical hyperkeratosis. It may not appear for several years after the drug has been stopped. Although chiefly of the squamous-cell variety, both basal-cell lesions and those with adenoid structure may occur in the same case and presumably from the same cause. Lesions on the trunk are generally of the superficial, flat variety and may simulate Bowen's disease. They may be permanently eradicated by thorough local treatment, unless far advanced. On the hands and feet, however, arsenical carcinoma is more likely to be of the cornifying type, at first producing a horny, papillomatous growth which later metastasizes with or without preceding ulceration. For the treatment of arsenical keratoses and carcinoma, radium therapy and sometimes surgical excision are recommended.

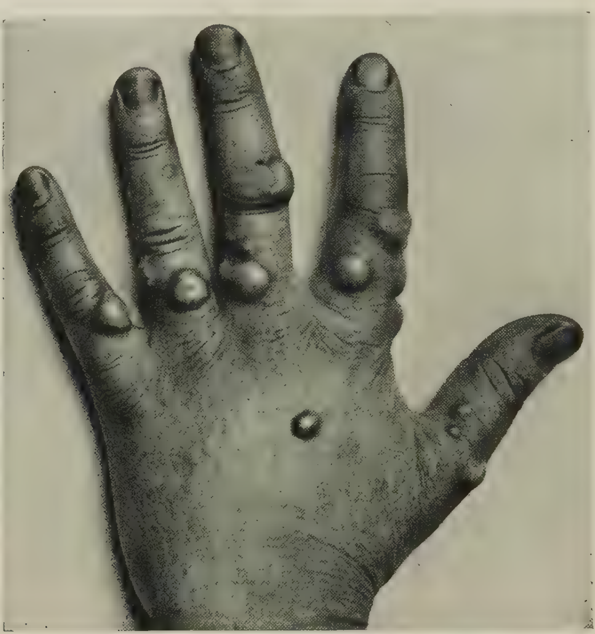

Fig. 179.—Bullous eruption due to the ingestion of the iodides. (Stelwagon.)

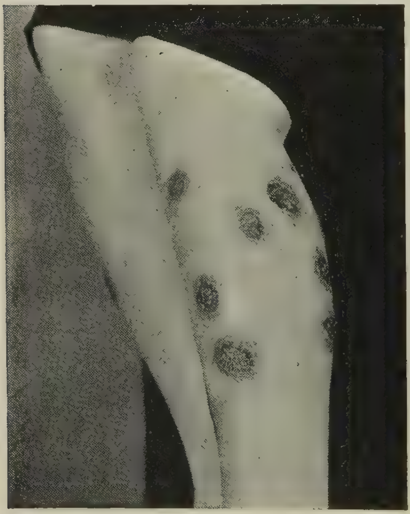

Fig. 180.—Iododerma of legs. (Courtesy of Drs. J. B. and Bedford Shelmire.)

Pigmentary disturbances frequently develop after a long-continued use of arsenic and may appear early in those who have had eruptions due to acute intoxication. The patches may be small and somewhat confluent, so that there is a dappled appearance, often widespread, or the patches may be large and regional. The color is brownish or sepia with a glistening sheen.

Gans and others have clearly shown that the pigmentation is a melanosis produced through some action of arsenic. The pigment contains lipoids and melanin, probably produced by the metabolism of the cells of the corium and, to a less extent, of the epidermis. The pigment is chiefly in the papillae and in the upper part of the corium, being located around the vessels and intracellularly. In the epidermis there is also an increase of pigment in the basal layer and here and there in the stratum spinosum and stratum granulosum, showing as intracellular granules in the cytoplasm around the nucleus. Arsenic is also present in large amounts in the upper corium, particularly in the papillae and about the pilosebaceous follicles.

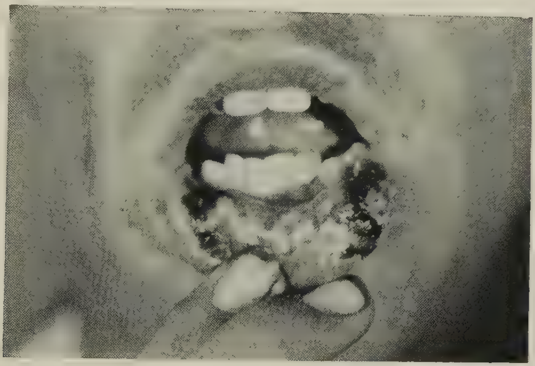

Fig. 181.—Luminal stomatitis in an epileptic. (Courtesy of Drs. J. B. and Bedford Shelmire.)

The pigmentation is accentuated in dark-skinned individuals and on parts of the body which are ordinarily pigmented, such as the areolae, and areas subject to pressure from clothing, as the sides of the neck. When the arsenic has been given for the treatment of some skin disease, the pigmentation is likely to be pronounced at the sites of the previous lesions. Arsenical pigmentation does not occur on the mucous membranes and tends gradually to disappear after the administration of the drug has stopped, the disappearance being hastened by the intravenous use of sodium thiosulphate solution. Areas affected by the pigmentation are likely to be dry and hyperkeratotic or scaly. The distribution is more limited than is observed in Addison's disease, in which affection there are usually an involvement of the mucous membranes and debilitation.

Hyperidrosis commonly precedes or accompanies the development of hyperkeratosis due to arsenic, occurring chiefly on the palms and soles.

Herpes zoster occurs after the use of arsenic, being due either directly to the drug or to a predisposition caused by the drug, to infection by the herpes virus. The production of arsenical neuritis and optic atrophy from the use of some arsenical compounds has also been observed, and arsenic has also caused herpes simplex both on the face and on the genitals. The nails become thickened and brittle and may be shed, due to the action of arsenic upon the matrix. Such changes are usually associated with hyperkeratosis of the palms and soles.

Arsphenamine may cause typical arsenical eruptions, but there are other manifestations which make it desirable to consider this subject separately. Stokes and Cathcart state that there is "an induced state of hypersensitiveness underlying the clinical manifestations, in part at least, from chronic or acute protein intoxication of bacterial origin, or, in other words, from focal or intercurrent infection." Klauder has found that a large percentage of cases of arsphenamine dermatitis occur following faulty venipuncture or when the drug has been injected outside of the vein. Schamberg has suggested that the combined use of mercury and arsenic might account for the cutaneous sensitiveness to arsphenamine; the failure to eliminate the arsenic, due to renal impairment from mercury, being responsible for the skin reaction. Stokes feels that there is "an unescapable element of hypersensitivity or allergic instability underlying the behavior of the patient to the drug." Arsphenamine dermatitis is apparently due to a sensitization to arsenic, but it is undetermined whether the drug acts directly or indirectly. Many theories have been advanced as to the etiology, one of the most important being that the dermatitis arises from an interaction between the arsenic and the tissue proteins. Contributary factors are other skin diseases, focal infections, and anemia.

The skin manifestations are varied and difficult to classify. All types of lesions are encountered, and in any one case they may be multiform. Mild reactions are common, but severe ones occasionally occur and may be fatal. The reactions may be observed after the first injection or at any time thereafter and, in some instances, there seems to be a hypersusceptibility created by a long rest interval between injections. The mild eruptions are usually erythematous, scarlatiniform, morbilliform, urticarial, and eczematous, and may be followed by desquamation. These are generally of short duration, and apparently due to anaphylaxis, being in the same category as the nitritoid crises. Herpetic eruptions and lichenoid eruptions are also encountered, sometimes fairly characteristic of lichen planus or lichen spinulosus. Rarely, a localized erythema perstans type of eruption occurs which flares up after each injection and which produces a fixed pigmentation.

Severe cases develop a generalized, exfoliative dermatitis, with a high temperature and a tendency to intercurrent infections by cocci, sometimes ending fatally. This severe type of arsphenamine dermatitis usually begins on the extremities as an eczematous or maculopapular eruption with slight scaling and itching, and becomes widespread with intense exfoliation in the course of a week. The skin is hot to the touch and intensely edematous, and there is swelling of the face and legs. Some cases are mild and disappear without constitutional symptoms. In others, a rise in temperature occurs, and although at the beginning it may be around 102 F., in severe cases a temperature of 105 to 106 F. may persist for weeks. The dermatitis quickly becomes universal and then remains more or less stationary. Sometimes it disappears in a few weeks, but more often it runs a protracted course over two or three months. During this period furunculosis is likely to develop on the skin, and any foci of infection from which the patient suffered prior to the onset are likely to become active. The loss of sleep due to itching and the loss of weight due to fever, restlessness, and low intake of food gradually reduce the patient to a state of skin and bones. The pulse is rapid, the mouth parched, the tongue swollen and coated; bronchitis and nephrosis commonly ensue. Death may come from intercurrent bronchopneumonia, abscess in the viscera, hemorrhage, or other causes. In patients who survive, the hair and nails fall out. A change for the better is denoted by a decrease of the fever, of the itching, and of the edema, and by an increase in the appetite and in composure. Progress is slow and at first there is a tendency to relapses, which should be kept in mind, so that sodium thiosulphate and other eliminative treatment are not stopped too soon. Gradually strength

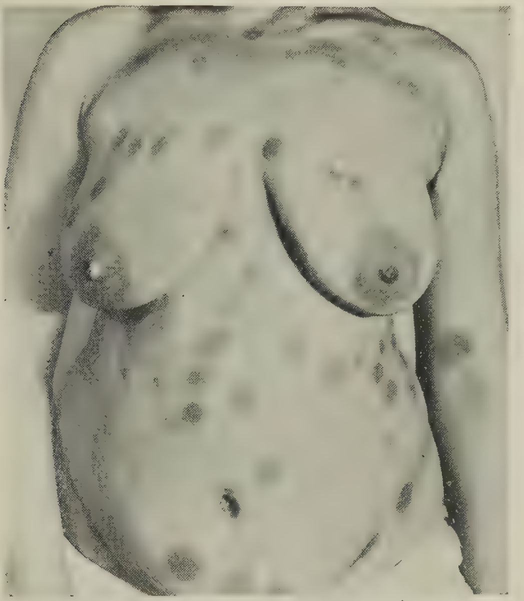

Fig. 182.—Phenolphthalein eruption.

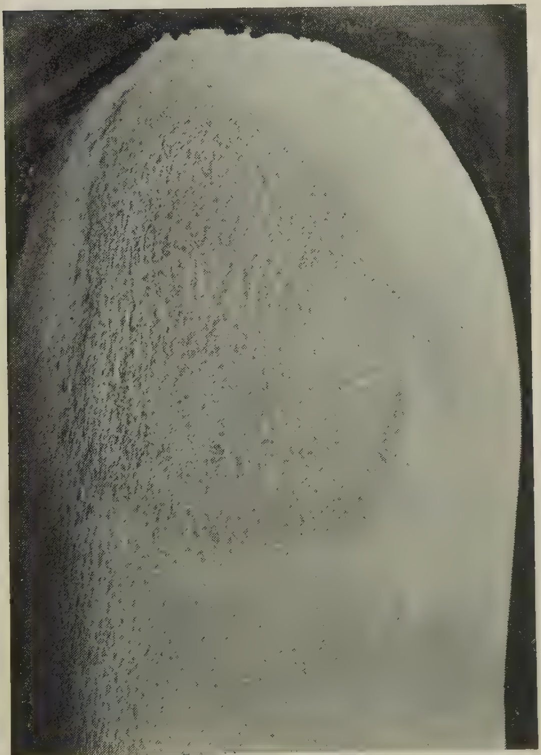

Fig. 183.—Erythema multiforme type of eruption caused by phenolphthalein.

returns and the patient regains his weight; a brownish pigmentation may persist for several months, and hair and nails are the last to return to normal.

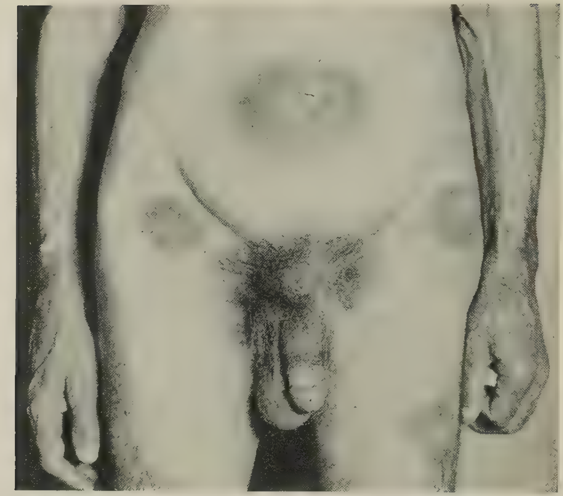

Fig. 184.—Erythema perstans type of eruption produced by phenolphthalein. (Courtesy of Dr. Theodore Rosenthal.)

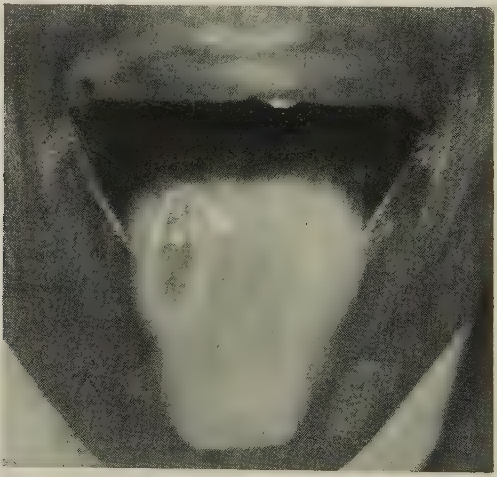

Fig. 185.—Ulcerative lesion on the tongue caused by phenolphthalein.

The *treatment* of arsphenamine dermatitis in a fully developed case is largely symptomatic. The patient is kept in bed, and attempts are made to relieve the itching by local applications of antipruritic drugs in oils or ointments.

Prescriptions

℞.	Liq. alumin. acetat.	ʒij
	Mentholis	gr. ij
	Adipis lanae	℥j

M. and S. Apply to affected areas freely.

℞.	Phenolis	ʒss
	Liq. carbonis deterg	ʒss
	Petrolat. liquid	q.s. ad. ℥viij

M. and S. Apply to scalp often enough to stop itching.

℞.	Phenolis	ʒss
	Mentholis	gr. v
	Calamine prep.,	
	Zinci oxidi,	
	Glycerini,	
	Ol. olivae,	
	Witch hazel	āā ℥j
	Aq. calcis	q.s. ad. ℥viij

M. and S. Apply to legs and trunk to allay itching.

Sodium thiosulphate is given both intravenously and by mouth, 1 Gm. daily in each manner in the beginning and gradually increased to 4 Gm. by mouth and 2 Gm. daily by vein, the latter divided in doses of 1 Gm. morning and night. Its administration is also effective in eruptions caused by other heavy metals. Nutrition should be maintained, and elimination increased as much as possible by the ingestion of fluids. The diet should consist of plenty of starchy foods, butter, milk, gruels, cereals, and vegetables, but should be low in protein content. Alkalies should be given by mouth. The fingernails should be clipped short and kept scrupulously clean. Furuncles or focal infections should be radically dealt with. Coal tar hypnotics should not be given, because they may increase the itching and aggravate the toxic skin condition. Paraldehyde in olive oil by rectum is of benefit, and for those patients who tolerate codeine well, small doses are beneficial.

Morphine should be avoided. The heart action should be watched and in case it is very rapid or irregular, small doses of tincture of digitalis are indicated, but there is always the danger that this drug will cause nausea or other gastric distress. In emergency, digifolin or digipuratum must be given hypodermically or intravenously. Roentgen therapy relieves the itching and diminishes the scaling.

Aspirin rarely produces cutaneous lesions, although erythematous, papular, and hemorrhagic eruptions have been described.

Atophan occasionally produces eruptions of the erythema multiforme type.

Barbital produces urticarial, erythematous, and bullous eruptions and others which resemble erythema multiforme.

Belladonna not infrequently produces scarlatiniform eruptions or isolated erythematous patches accompanied by itching. Children are especially susceptible. *Atropine* may produce similar manifestations.

Benzoic acid and *sodium benzoate* may rarely cause erythematous or papular eruptions.

Bismuth produces a slate-colored line upon the gums and stomatitis, and has been credited with the causation of exfoliative dermatitis[1] and herpes zoster.[2] Treatment is by sodium thiosulphate, as described.

Borax and *boric acid* may cause erythematous, papular, scaly, vesicular or multiform lesions, or produce edema of the eyelids and conjunctivitis.

Bromides commonly produce skin eruptions which are fairly distinctive. They may occur after a small dose or after protracted use of the drug and they may be seen in children, the drug being transmitted by the milk of nursing mothers. The commonest lesions are acneiform with pustules of a rather inflammatory type which are observed not only on the face but on parts of the trunk and in hairy regions. The lesions are frequently vesicular and may fuse to form large patches which become suppurative and crusted or, in the course of time, form vegetative growths. These are soft and occur most often on the legs. Bullous lesions also appear, as well as nodules, which are tender. Wile, Wright, and Smith demonstrated that there was a ready substitution of chloride for bromide in the body fluids, and suggested the use of salt solution intravenously in cases of bromide eruption.

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[1] Pinard, M., and Marassi: Exfoliative Dermatitis after Intramuscular Injections of Bismuth, Bull. et mém. Soc. méd. d. hôp. de Paris, 46: 1434–1435, Nov. 3, 1922.

[2] Sézary, Pernet, and Gallerand: Herpes Zoster from Bismuth, Bull. Soc. franç. de dermat. et syph., 33: 654–656, Nov., 1926. Martineau, M.: Herpes Zoster after a Bismuth Treatment, Ibid., 33: 657, Nov., 1926.

A certain amount of shock may develop immediately after the injection and also a moderate nephritis, which gradually disappears. The latter was probably produced by the bromine, which was found promptly in the urine after each injection of salt solution. They used 100 to 400 cc. decinormal saline solution intravenously at intervals of three or four days for from two to five injections. This treatment caused pronounced benefit to cutaneous lesions. The taking of large quantities of table salt by mouth achieves the same results, though less rapidly. Treatment with roentgen rays produces

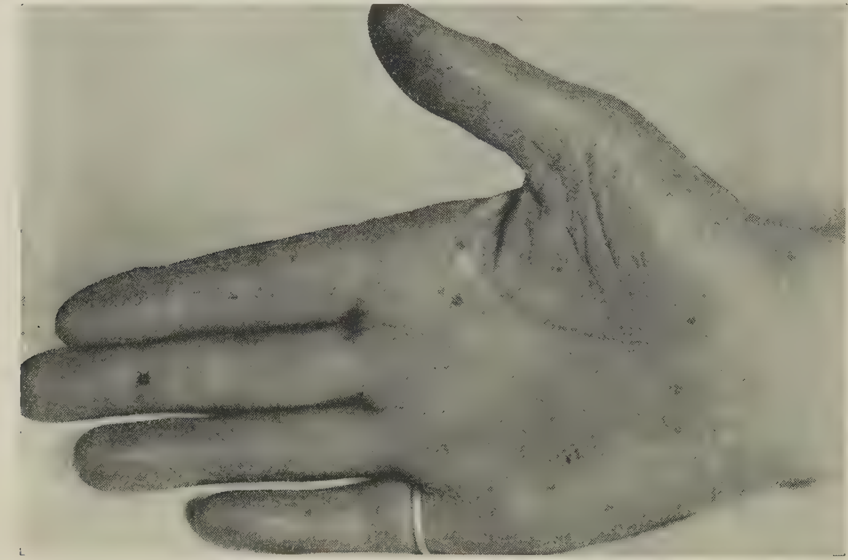

Fig. 186.—Arsenical palm. Note dryness of the skin, scaling, and keratoses.

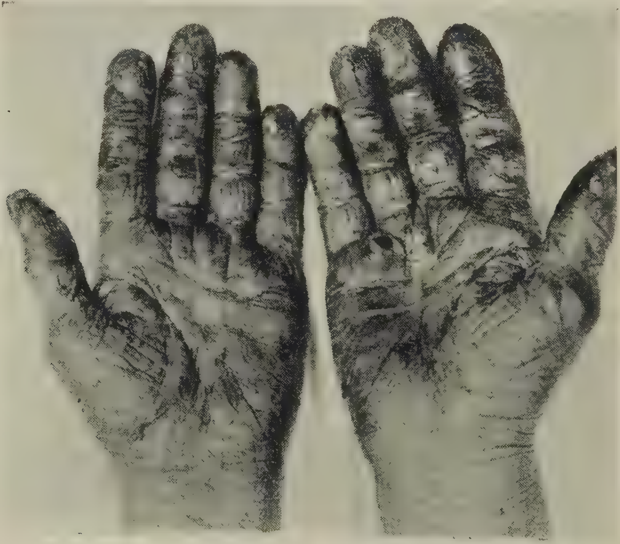

Fig. 187.—Chronic arsenical dermatitis.

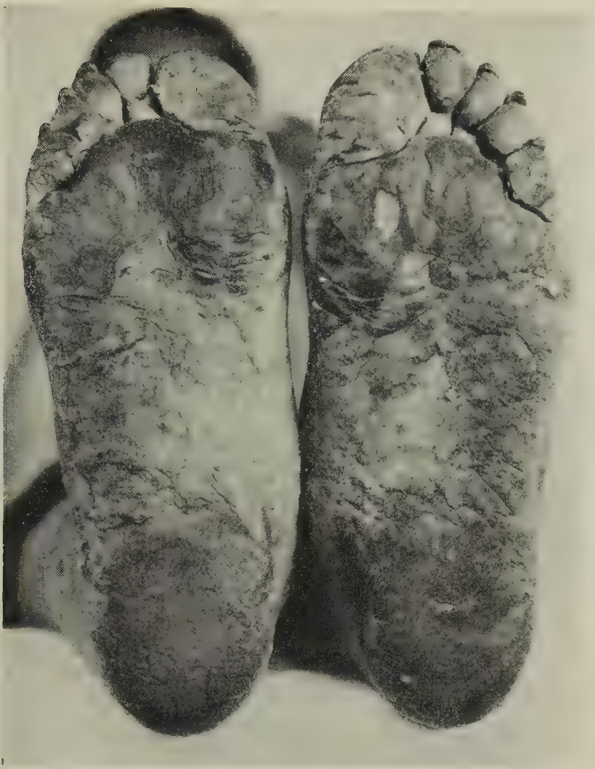

Fig. 188.—Hyperkeratosis due to arsenic.

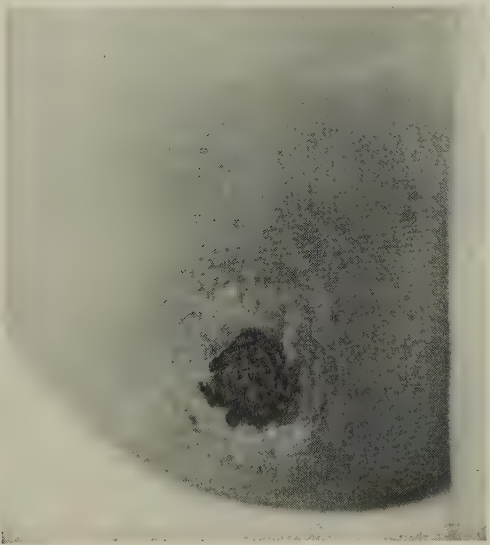

Fig. 189.—Keratosis of the nipple produced by arsenic.

involution of the acneiform, nodular, and granulomatous lesions caused by bromine or iodine.

Cannabis indica may rarely cause itching and vesicular lesions and provoke temporary pigmentation.

Cantharides may produce an erythematous and papular eruption which occurs about the genitals.

Capsicum rarely produces an erythematous or papulovesicular eruption.

Chloral frequently causes eruptions which may be scarlatiniform erythemas or localized erythematous patches, papules, vesicles, bullae, and pustules. Acneiform lesions and erythematous patches with crusts and pustules are common. Some of the lesions may be hemorrhagic and at times there is pyrexia.

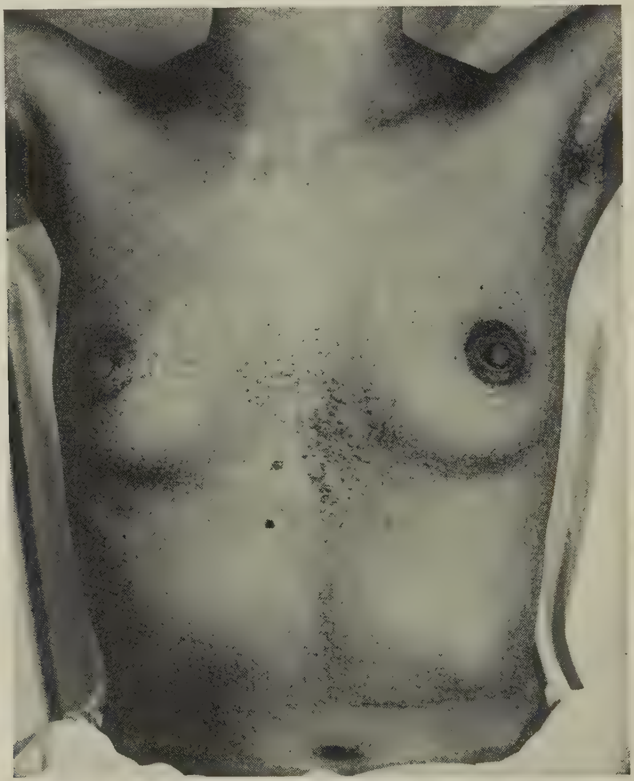

Fig. 190.—Arsenical pigmentation in a young epileptic. (Courtesy of Dr. James H. Mitchell.)

Chloralamide and *chloretone* produce lesions similar to chloral, usually of a mild character.

Chloroform may provoke an erythematous or purpuric eruption.

Cinchophen produces urticarial and erythematous eruptions, sometimes scarlatiniform.

Copaiba frequently produces erythematous, vesicular or bullous lesions associated with intense itching or burning. At times there is urticaria. The lesions may be followed by desquamation. At the onset there may be sore throat and constitutional symptoms, including fever.

Cubeb produces lesions similar to copaiba.

Digitalis may rarely cause erythematous, scarlatiniform, and papular eruptions, which may be followed by desquamation.

Ergot rarely, particularly in America, may cause eruptions which result from eating ergoted grain. The lesions are vesicular, bullous, pustular, and gangrenous (Sutton).

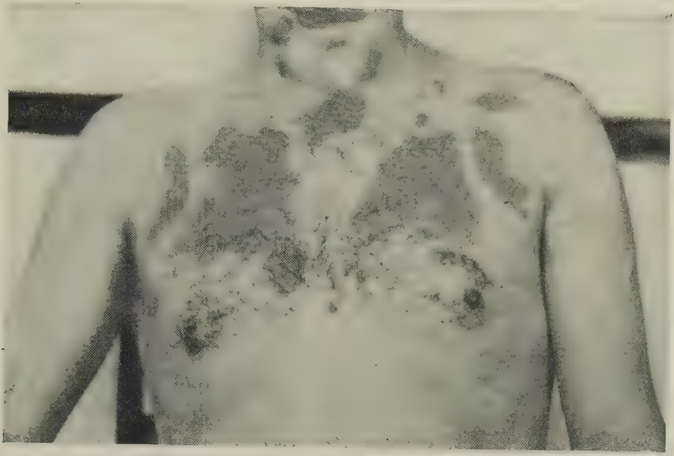

Fig. 191.—Urticarial eruption which developed within a few hours after each injection of arsphenamine. (Courtesy of Dr. Joseph V. Klauder.)

Eucalyptus may cause erythematous and urticarial eruptions.

Gold produces erythematous, urticarial, and exfoliative eruptions. Kiess reports a case which resembled pityriasis rosea and healed with pigmentation.

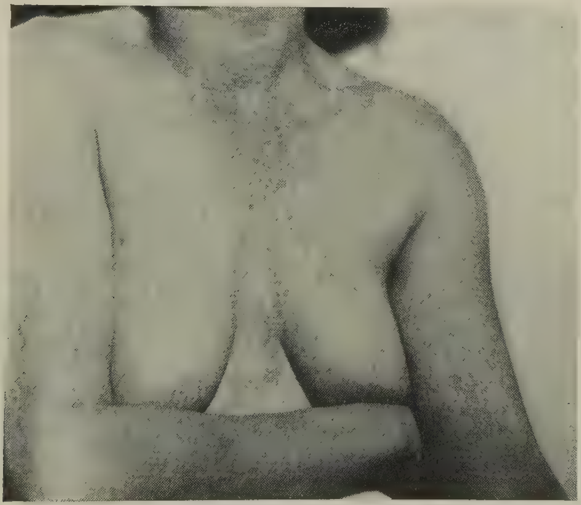

Fig. 192.—Morbilliform type of arsphenamine dermatitis. (Courtesy of Dr. Joseph V. Klauder.)

Guaiacum causes erythematous and urticarial eruptions.

Hexamethylenamine may produce localized erythematous lesions or generalized morbilliform eruptions.

Hyoscyamus may produce erythematous eruptions.

Iodides commonly cause skin eruptions and the expressions may be of many different varieties. The commonest manifestation is the acneiform eruption with numerous small follicular pustules, each surrounded by a ring of hyperemia. Vesicular and bullous lesions from iodides are also common and may become ulcerative and crusted. Vegetative or fungating lesions are occasionally encountered and may be mistaken for true neoplasms. One case which was diagnosed epithelioma of the back of the hand by several practitioners was referred to me in consultation for an opinion as to whether the lesion could be handled successfully by radiotherapy instead of by amputation of the hand, which was about to be undertaken. The lesion was not an epithelioma, but was a fungating iododerma. Purpura and urticaria are common manifestations of

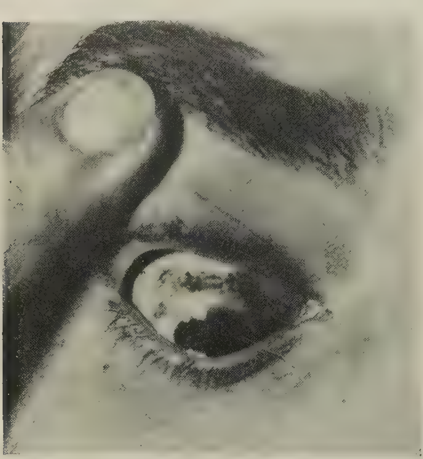

Fig. 193.—Purpura of the conjunctiva due to arsphenamine.

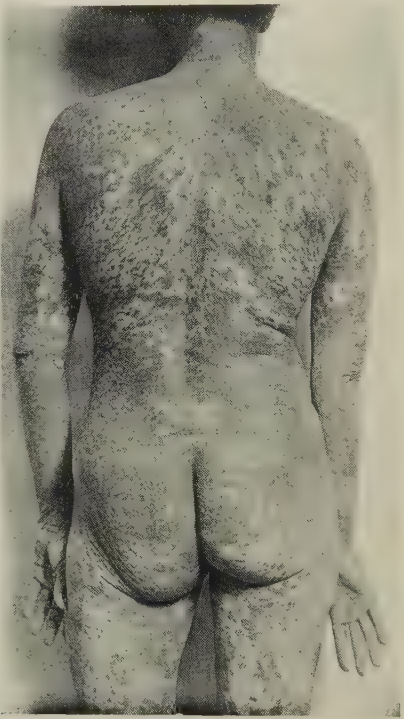

Fig. 194.—Lichen planus after arsphenamine injections. (Courtesy of Dr. Lawrence K. McCafferty.)

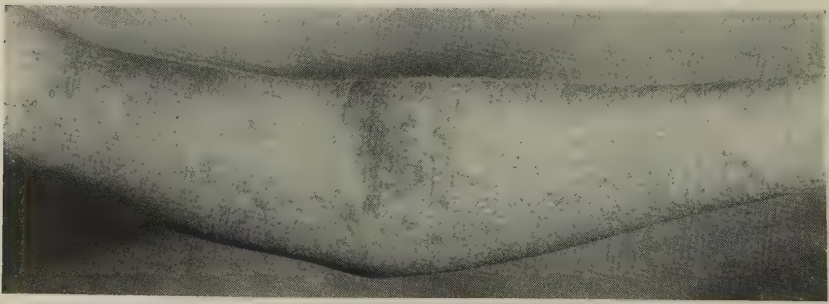

Fig. 195.—Brawny swelling of the arm, with vesiculation and crusting of the skin, characteristic of early arsphenamine dermatitis. (Courtesy of Dr. Sally D. Moon Adams.)

mild iodism. The eruptions also may be furuncular, carbuncular, or of the erythema multiforme or erythema nodosum types. Treatment is the same as that described for eruptions due to bromides.

Iodoform may produce macular, papular, vesicular, and bullous lesions.

Iron, according to Sequeira, has produced acneiform pustules.

Jaborandi and *pilocarpine* rarely may produce urticarial and erythematous eruptions.

Luminal causes generalized pruritus and erythema, urticaria, morbilliform eruptions, jaundice, and bullae. There may be associated pyrexia, and, after disappearance, moderate hyperpigmentation. In the mouth and on the genitals bullous and erosive lesions are characteristic. I was called to see one patient with widespread, bullous eruption, due to taking $\frac{3}{4}$ grain of luminal daily for one month. The patient had a temperature of 102 F. and was in intense agony from large bullae which were distributed profusely over the entire body. Most of the lesions were as large as walnuts. Each sole was completely covered by two large bullae, one on the heel and one on the ball of the foot. From each of these bullae I removed over 100 cc. of serum at the time of my first visit.

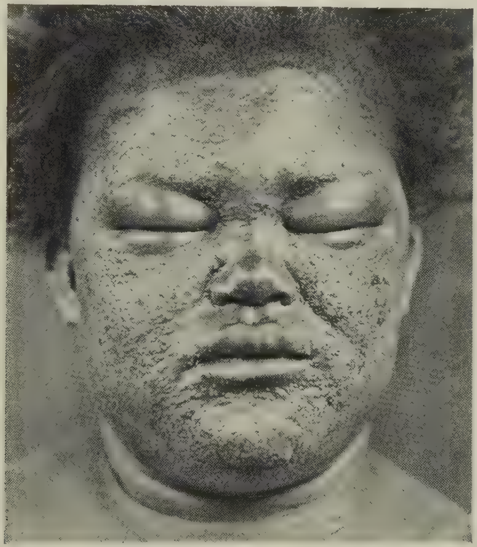

Fig. 196.—Arsphenamine dermatitis with edema. (Courtesy of Dr. A. Benson Cannon.)

Medinal causes urticarial and erythema multiforme eruptions.

Mercury infrequently causes erythematous and scarlatiniform eruptions or, rarely, a generalized exfoliative dermatitis. The eruptions may resemble folliculitis, erythema multiforme, urticaria, purpura, measles, and pemphigus. Scarlatiniform eruptions are the most common. In addition to the skin manifestations, mercury produces a stomatitis. Large doses, a cumulative effect, hypersusceptibility, and poor teeth may lead to the development of lesions which vary from a simple gingivitis to severe ulcerations. Goeckerman has reported a discoloration of the skin following the use of a cosmetic containing calomel. Wright believes that mercury may call forth almost as many cutaneous reactions as arsphenamine.

Morphine and *opium* cause erythematous, morbilliform, scarlatiniform, and urticarial eruptions which itch intensely and are usually followed by desquamation.

Pantopon produces similar manifestations.

Phenacetin causes erythematous, urticarial and erythema multiforme types of eruptions.

Phenolphthalein produces bullous and erosive lesions in the mouth and on the genitals and fixed skin lesions. The "fixed eruption" is a persistent, smooth, macular plaque, varying in size up to several centimeters. The plaques are polychromatic, usually slate colored or violaceous, with ill-defined borders. At times there are slight infiltration, scaliness, itching or burning, but these features are usually insignificant. In the course of time the color changes by the addition of brownish tints and there may be stippled depigmentations in the central part of the patch. Generalized erythematous eruptions resembling measles, scarlet fever, or erythema multiforme may also occur.

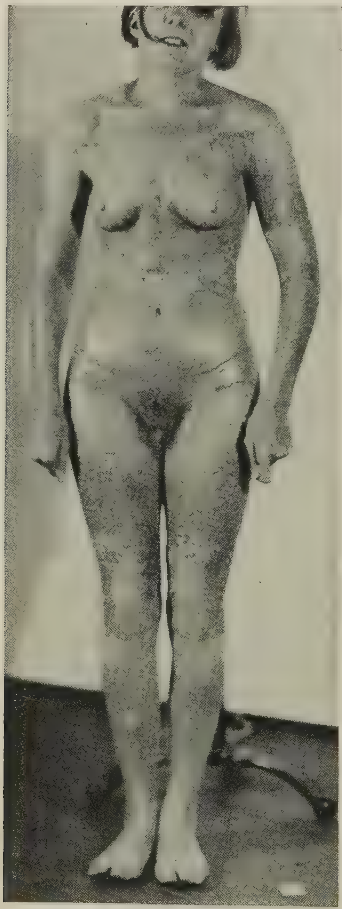

Fig. 197.—Widespread, oozing, and exfoliative dermatitis due to arsphenamine.

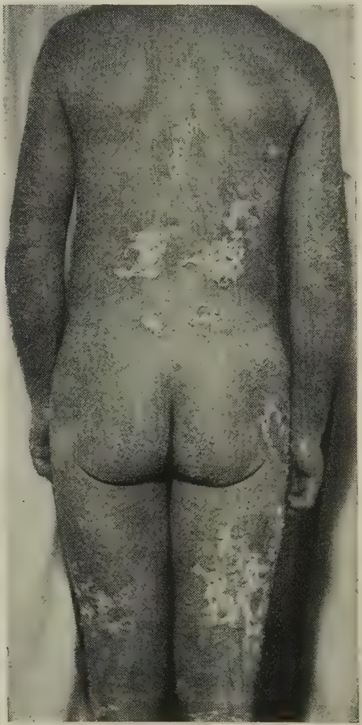

Fig. 198.—Exfoliative type of arsphenamine dermatitis. (Courtesy of Dr. Joseph V. Klauder.)

Potassium sulphocyanate is used for hypertension and produces generalized exfoliative dermatitis.

Pyramidon frequently causes eruptions of the erythema multiforme type, usually with intense edema. Lesions may also be localized erythematous, urticarial, and herpetiform patches.

Quinine not uncommonly produces a scarlatiniform erythema or general urticaria. Other types of eruptions are encountered: erythema, purpura, vesicles, bullae, eczematous lesions, all associated with severe itching and often followed by desquamation. Gangrene has been reported after the use of quinine and urea hydrochloride.

Salicylates and *salicylic acid* rarely cause erythematous, urticarial, vesicular or bullous lesions. Eruptions may be scarlatiniform or morbilliform and followed by profuse desquamation of the epidermis in large sheets.

Salol may cause blotchy, erythematous eruptions.

Santonin may cause erythematous and morbilliform eruptions.

Serum (animal) commonly causes urticarial or erythematous eruptions. They may be morbilliform or scarlatiniform or may resemble erythema multiforme. Such manifestations are caused occasionally by injections of antitoxins, most often of diphtheria, tetanus or erysipelas. Usually the eruptions are accompanied by fever, generalized adenopathy, and effusions into the joints. Although the manifestations may arise anywhere on the skin, the favorite sites are the thighs and buttocks. Vesicles, bullae, and even hemorrhages may be present. Often there is an associated edema of the eyelids, hands, genitals, and feet. Serum eruptions may occur from one to thirty days after injection, generally from the sixth to the tenth day. They are prone to relapses, and may be followed by some desquamation. Attacks last from a few hours to a week, and rarely the erythema multiforme or purpuric types may persist for as long as six months.

Silver or its salts, after prolonged use, may produce a metallic blue discoloration of the skin (argyria), either generalized or localized. The use of argyrol, silver nitrate, and allied drugs to irrigate body cavities is usually responsible for the affection. The intradermal injection of a mixture of 1 per cent potassium ferricyanide with 6 per cent sodium thiosulphate removes a large part of the silver from the skin in old cases of argyria with deep pigmentation.[1]

Sodium thiosulphate may produce a purpuric or vesicobullous eruption.

Sulphonal rarely produces erythematous and scarlatiniform eruptions.

Turpentine may cause erythematous, pruritic, papular, and morbilliform eruptions.

Veronal may provoke erythematous, urticarial, papular, vesicular or bullous eruptions. Morbilliform and scarlatiniform manifestations occur, and there may be erosive lesions in the mouth.

[1] Stillians, W. W., and Lawless, T. K.: The Intradermal Treatment of Argyria, J. A. M. A., 92: 21, Jan. 5, 1929.

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CHAPTER XIV

ERYTHEMA AND URTICARIA

ERYTHEMA

The term "erythema" signifies a hyperemia—a congestive or exudative redness—of the skin, either localized or widespread. It is usually transient and is blanched momentarily under pressure of the finger. Erythema is the first and the most common objective skin reaction produced by an internal or external irritant.

In localized erythema the patches vary in size, are round or irregular in shape, pink or red, and sometimes raised above the surrounding skin. Localized erythema may be due to external causes, such as friction, pressure, sunlight, roentgen rays, and radium. Chemical, vegetable or animal irritants, such as the stings of insects, and septic discharges may be other causative factors. Erythemas due to heat, sunlight or pressure are of minor importance and will not be dealt with here; those from roentgen rays and radium are discussed under radiodermatitis; those from chemical and vegetable irritants are covered under dermatitis venenata. Localized erythema may also result from bacterial toxins circulating in the blood, and from certain foods, drugs or vaccines, or from neurogenic or reflex disturbances arising in the gastrointestinal or reproductive systems, or from peripheral nerve injuries or psychic states. Many more or less descriptive names are applied to localized erythemas arising from diverse causes. Erythema intertrigo is an erythema of apposed skin surfaces, usually in the groins, armpits, and beneath pendulous breasts, due to friction, warmth, and sweat. Erythema solare is a redness caused by the heat of the sun; erythema caloricum, a similar condition produced by any kind of heat; erythema pernio (chilblains), a purplish erythema due to exposure to cold.

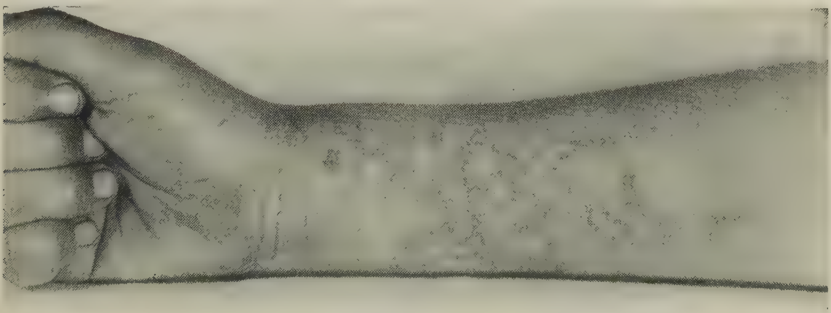

Fig. 199.—Circinate type of toxic erythema.

Generalized erythemas vary greatly in their appearance, extent and distribution, being most marked on the trunk, upper arms, thighs, and face. The eruption may be made up of red macules, varying in size from a pinpoint to a pinhead, and so closely studded together as to form large irregular patches over the entire body. There is nearly always a tendency to involve the follicles. In some instances the eruption may resemble scarlet fever (erythema scarlatiniforme; erythema scarlatinoides); in other cases the rash may suggest measles (erythema morbilliforme). Dermographia or urticaria is often associated with erythema. The subjective symptoms are rarely pronounced, but they are most marked just before redness appears, after which there is a gradual diminution. There may be itching, pricking, or burning, which sometimes provoke scratching, and secondary infection by the staphylococcus. Occasionally desquamation of the epidermis, defluvium of the hair, or changes in the nails may follow an attack.

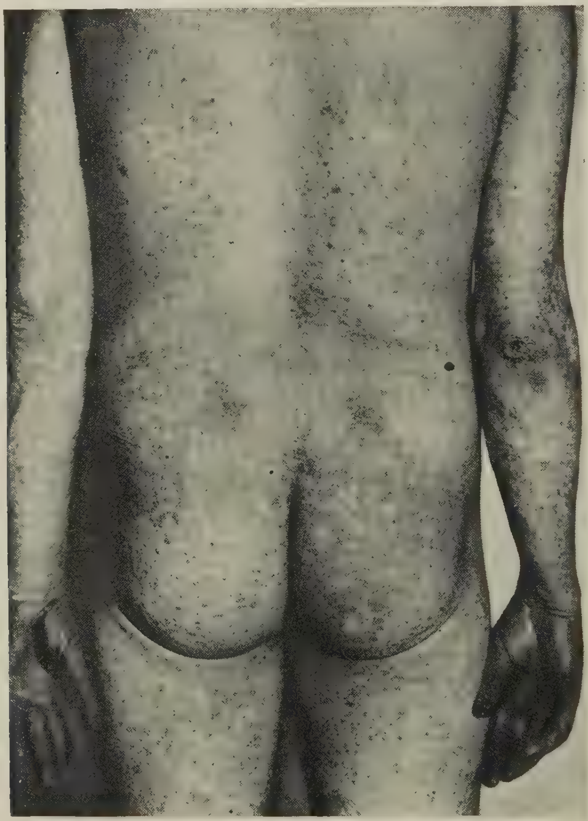

Fig. 200.—Morbilliform type of toxic erythema.

Generalized erythemas are usually of internal origin. The most common cause is hypersensitiveness to certain foods such as shellfish, berries, or cheese. Drugs, especially the coal tar products, copaiba, chloral hydrate, quinine, and belladonna produce erythematous, as well as other types of eruptions (which are discussed in the chapter on Dermatitis Medicamentosa). Autogenous toxins from the gastro-intestinal tract and serum injections are other causes. Frequently toxic erythemas develop in the course of systemic diseases such as typhoid fever, rheumatic fever, malaria, or pneumonia. In such instances they are to be differentiated from drug eruptions.

Scarlatiniform erythema is differentiated from scarlet fever by the fact that constitutional symptoms are absent or very mild in the former, whereas in the latter they are likely to be severe and accompanied by vomiting. In toxic erythema, the tongue is usually normal, as is the buccal mucous membrane, except occasionally when it is slightly hyperemic. However, in scarlet fever the tongue is coated and its papillae are enlarged and red; the tonsils are enlarged, inflamed, and covered with a purulent exudate. The differentiation is facilitated by the short duration of the toxic erythema, the occasional history of previous attacks and by the negative Dick test, but, as stated, there may be considerable desquamation after scarlatiniform erythema.

Treatment.—Every effort should be made to determine the exact cause of the erythema, and when discovered this should be eliminated or suitably treated. Idiosyncrasies to foods or drugs should be investigated and gastrointestinal disturbances should be corrected by diet and internal remedies[1] as indicated. Castor oil and colonic irrigations are useful in practically all toxic cases. Ephedrine sulphate may be of value when the blood pressure is low. Soothing baths containing starch, bran or sodium bicarbonate are beneficial. Soap is to be avoided. Cleansing is effected by mineral or olive oil. The baths should be followed by lotions containing calamine or tincture of benzoin. After the inflammation has largely subsided zinc oleate powder or cold cream should be applied.

While erythemas usually disappear under specific treatment indicated by the etiology, including the removal of the causative factor and simple topical applications, it is interesting to note that fractional unfiltered *x*-ray treatment produces prompt involution in some troublesome persistent eruptions due to serum or internal toxins. It is particularly indicated in cases where there is eczematization, or pustulation from secondary infection. One half erythema dose to the affected areas usually induces a cure. Occasionally simple localized erythemas are benefited. If necessary, further treatment of $\frac{1}{4}$ E. D. may be given after an interval of one week. Thereafter the dosage should be very small, but such subsequent treatment is usually not necessary.

ERYTHEMA MULTIFORME

Synonym.—Erythema exudativum multiforme.

Hebra's conception of this disease has been gradually enlarged until the term now is applied not only to the simple idiopathic recurrent eruptions usually limited to the hands, forearms, face, and neck, which last for a few weeks, but also to a variety of similar manifestations of a clearly toxic or infectious nature, which are often more severe and more lasting.

The eruption is acute, polymorphous, exudative, bright or dark red, and symmetrically distributed. The lesions may be macular, papular, urticarial, bullous or hemorrhagic. The main sites of predilection are the upper part of the face, the neck, forearms, legs, and the dorsal surfaces of the hands and feet. The mucous membranes of the entire body are occasionally involved.

Varieties of erythema multiforme are named according to the more prominent features of the lesions composing the eruption: Erythema annulare; erythema bullosum; erythema circinatum; erythema iris; erythema nodosum; erythema papulatum; erythema perstans; erythema purpuricum; erythema tuberculatum; erythema urticatum, and erythema vesiculosum. In addition to these descriptive terms, it is customary to divide the disease into the maculopapular and vesicobullous types.

The characteristic lesions of the maculopapular type are bright-red, well-defined, rounded, edematous macules or flat-topped papules which have a tendency to spread peripherally, and to fuse into polycyclic patches.

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[1] See page 351.

Variegated tints may be a feature, particularly bluish and yellowish mixtures with red. A special type, erythema iris, is characterized by concentric rings of different colors, found chiefly on the dorsa of the hands and wrists and on the ankles. The vesicobullous type occurs as discrete or grouped vesicles or bullae, more often the latter, surrounded by a hyperemic ring. The extremities are sites of predilection, but other areas, particularly the buccal mucosa and glans penis. may be involved.

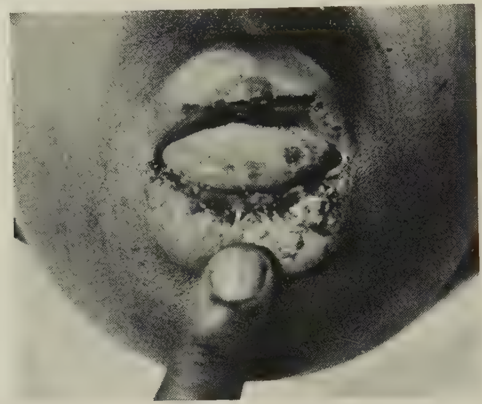

Fig. 201.—Characteristic involvement of the lips and tongue in erythema multiforme.

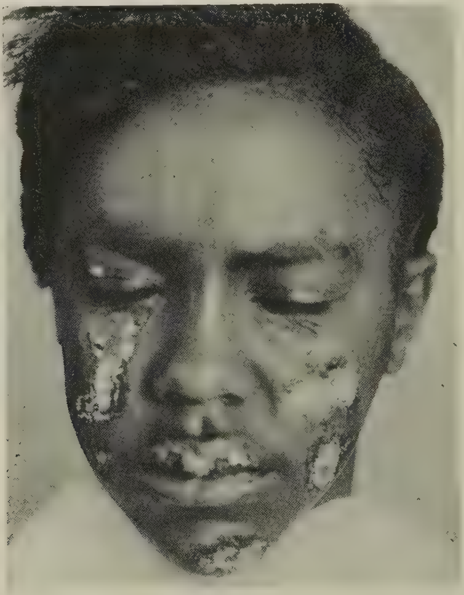

Fig. 202.—Erythema multiforme. Note annular lesions on cheeks and the involvement of the upper lip.

Diagnosis.—Different varieties of erythema multiforme may simulate other dermatoses. The maculopapular type may be confused with the maculopapular syphilide, with urticaria and drug eruptions. As has been stated, many drugs will produce eruptions with the characteristics of erythema multiforme, and an attempt should be made to elicit the history of the taking of medicines in all cases of this affection. Annular lesions of the disease may be confused with pityriasis rosea and ringworm. Vesicular and bullous types may be difficult to distinguish from dermatitis herpetiformis and pemphigus, under which headings the subject is further discussed. In occasional cases erythema multiforme produces slightly elevated, erythematous plaques on the nose and cheeks which simulate lupus erythematosus. They are distinguished from the latter by a comparatively short duration of but a few weeks, and by the absence of atrophy or adherent scales with horny follicular plugs. Eruptions of erythema multiforme usually involute after a short period without leaving sequelae.

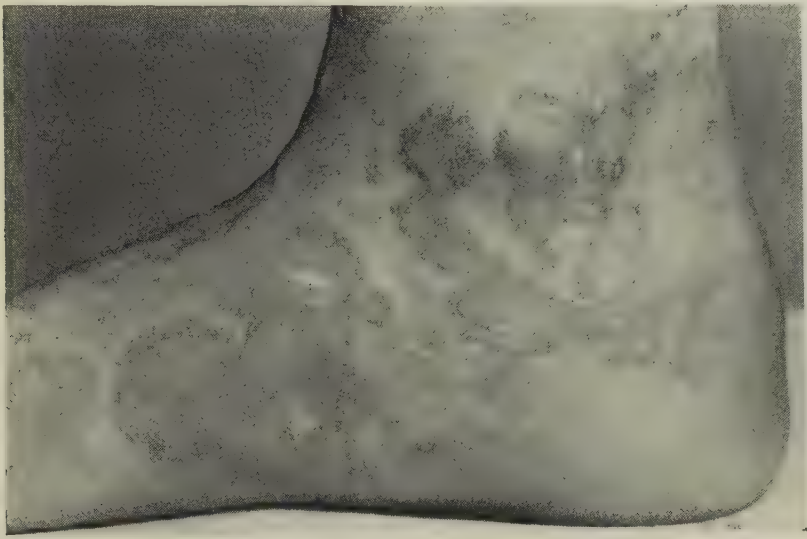

Fig. 203.—Erythema multiforme. Macular configurate lesions in a common location.

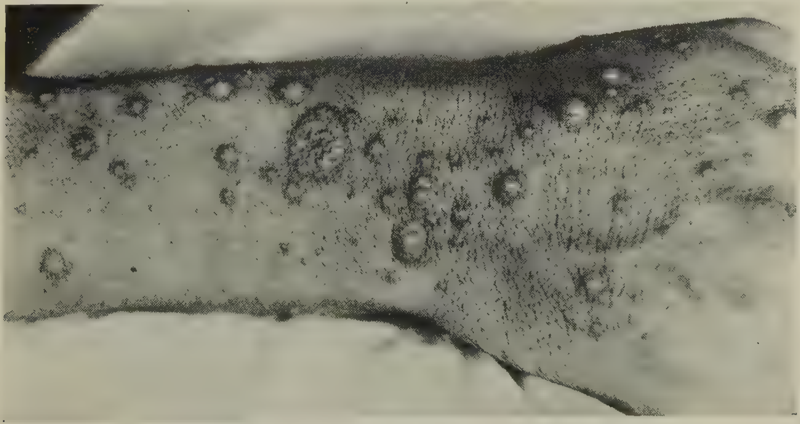

Fig. 204.—Erythema multiforme bullosum.

Etiology.—The disease is known to occur more often in the spring and fall of the year, possibly because of dampness and rain. Eruptions following the ingestion of stale meat, fish, oysters, *et cetera*, have been observed often enough to favor the toxic theory of absoption of substances of decomposition, bacterial and otherwise. Parker and Hazen have studied a number of cases occurring in the course of such diseases as typhoid and diphtheria which seemed to be due to toxins. Lain, Chipman, and others have recently associated erythema multiforme with focal infections of the teeth, tonsils, and accessory air sinuses. A few cases have been reported which seemed to result

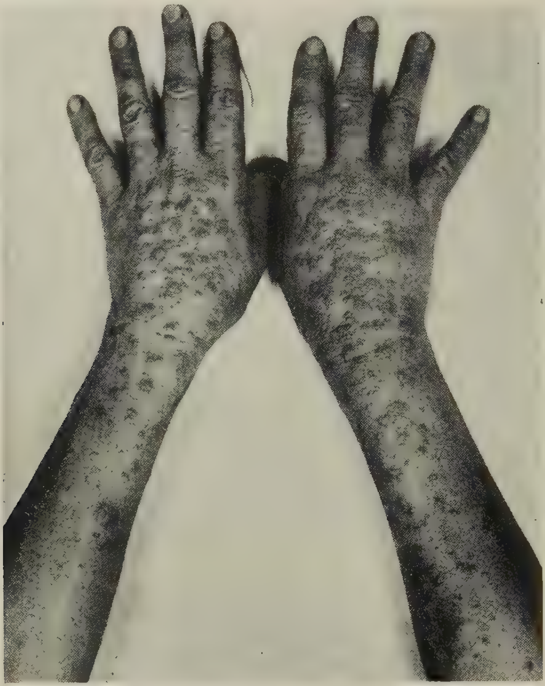

Fig. 205.—Erythema multiforme. Papular lesions in a typical location.

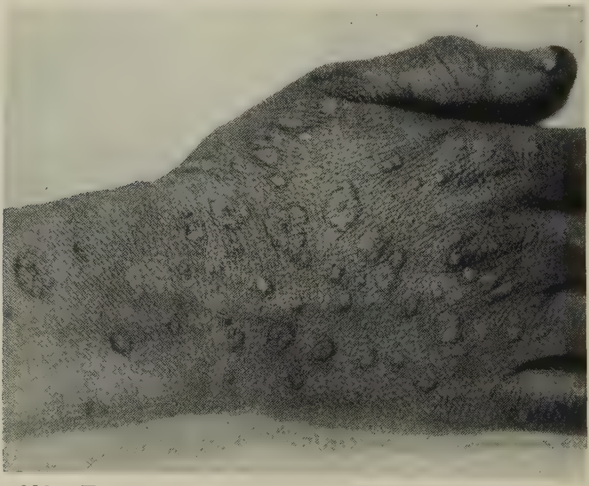

Fig. 206.—Erythema multiforme. Annular and papular lesions.

from uterine disorders, fetal necrosis, and other severe disturbances of the female reproductive organs. During pregnancy erythema multiforme is often of the gravest significance and may necessitate abortion.

Individuals seem to be affected when they become tired, the eruption apparently being more often the result of disturbed absorption rather than an idiosyncrasy to any particular food. During the process of digestion the foods are simplified chemically into harmless substances, but if the threshold of absorption permits more complicated transition products to enter the blood stream, these act as foreign products causing toxic symptoms. Patients frequently eat, without any symptoms, foods which at other times produce erythema multiforme or urticaria. Nitrogenous foods are especially likely to cause such eruptions.

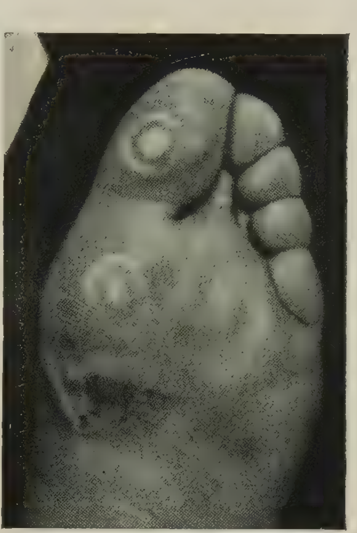
Fig. 207.—Erythema multiforme iris. (Stelwagon.)

Treatment.—As a routine measure, the diet is restricted along the lines indicated for urticaria, with due attention to elimination, and alkalies are administered. In long-standing cases, after the exclusion of food and drug idiosyncrasies, a search should be made for focal infections by streptococci. The skin tests and subsequent desensitization tests with fresh cultures of bacterial flora from the intestines, as described on page 384, are often of some value. Intracutaneous and hypodermic food protein tests are rarely helpful. When the blood pressure is low, ephedrine and general tonic measures to increase it are advisable. Subcutaneous injections of adrenalin and pituitrin may give temporary relief. Such treatment should be combined with rest and recreation. Exercise, even though moderate, must be cautiously taken, for it often provokes discomfort or an outbreak of lesions. Following the removal of the suspected cause, desensitization by protein injections and improvement of the general tone of the patient are important indications. However, in the pursuit of this régime, certain drugs should be avoided, as they may produce similar eruptions in hypersensitive people. The coal tar derivatives, analgesics, hypnotics, and laxatives, especially those containing the phenol radical, and the salts of iodine, bromine, and quinine, are the principal offenders. Topical applications should have the general composition of those given for erythema and urticaria. Where the lesions are made up of vesicles and pustules, antiseptic applications of ammoniated mercury ointment, 10 grains to the ounce, may be employed with benefit.

Generalized exposures of ultraviolet light may be given for tonic effect by the technic already described. These may be combined with local irradiation of the lesions. I have seen local benefit from *x*-ray treatment, although the observation is interesting because of its novelty rather than its practicability. The following case illustrates improvement following roentgen therapy.

A patient, four months pregnant, was suffering from a persistent widespread bullous eruption with symmetrical involvement of the forearms. One half of an erythema dose of unfiltered x-rays to one forearm produced prompt involution of the treated area, whereas the lesions on the untreated extremity showed no improvement. There was a striking difference in the two forearms four to ten days after the x-ray treatment, following which the patient left my observation and returned to the country, to the care of Dr. Samuel Pierson, under whose supervision the disease cleared up and successful labor followed.

Gouin and Bienvenue have used roentgen radiation over the cervical sympathetic in 12 cases of erythema multiforme with beneficial results equalling those achieved by this method in lichen planus. They have also had good results by the same technic in urticaria and prurigo, but not constantly.

Granuloma Annulare (Ringed Eruption, Lichen Annularis).—Granuloma annulare is an uncommon, peculiar nodular, ringed eruption which has a predilection for the hands and fingers, and occurs occasionally elsewhere. The individual nodules are white or ivory colored, or semitranslucent and are conglomerated into more or less incomplete rings, the centers of which are often purplish red and sometimes atrophic. A small purplish halo may surround the lesions.

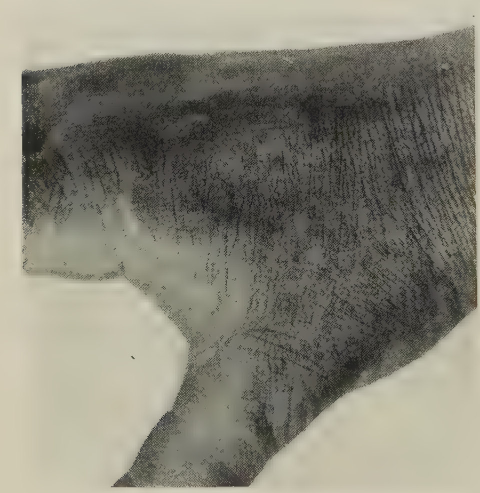
Fig. 208.—Granuloma annulare.

The condition chiefly affects children, usually beginning on the lateral or dorsal surfaces of the fingers or hands as a white or dullish erythematous, flat-topped nodule, which slowly spreads peripherally and, at the same time, undergoes central involution, so that lesions, roughly annular, are formed. The lesions may be single or multiple, but are seldom over a half dozen in number. They may coalesce and sometimes form scalloped patterns or firm plaques. The affection develops slowly and rarely involutes spontaneously. In many ways granuloma annulare resembles erythema elevatum diutinum, a type of erythema multiforme. The direct cause of the affection, however, is unknown. It is sometimes classified as a tuberculide.

The lesions respond rapidly to suberythema exposures of x-rays, radium or to ultraviolet light. Where x-ray treatment is employed, $\frac{1}{2}$ E. D., unfiltered, is given at intervals of three weeks, with the skin surface shielded to within 1 inch of the border of the lesion. The radium technic consists of a contact exposure with a flat applicator filtered through 0.5 mm. lead, a suberythema exposure of between 3 and 5 mg. hours per square centimeter being given. Good results follow the use of both carbon arc or mercury arc ultraviolet lamps, with third degree erythema exposures to the local area once weekly. The persistent use of 2 or 3 per cent salicylic acid ointment or 5 per cent salicylic acid in flexible collodion is occasionally a simple and effective method of treatment.

Erythema Elevatum Diutinum.—This affection is a persistent type of annular erythema multiforme resembling granuloma annulare and believed by some to be a clinical variety of it. The lesions are elevated, flat purplish plaques, which occur most often over the joints in young women. The affection responds to the treatments given for erythema multiforme and granuloma annulare. Either roentgen or ultraviolet therapy in one or two exposures is usually curative.

Erythema Nodosum (Dermatitis Contusiformis).—This disease is often classified as a type of erythema multiforme, to which it is closely related. The eruption consists of symmetrical, nodular, tender lesions on the shins. The size of the nodules varies from 1 to 5 cm., and the skin over them is bright red, smooth, and shiny. Ulceration is exceptional. The lesions occur also on other parts of the extremities, on the buttocks, and rarely on the face. The nodules last a few days or weeks, appearing in crops, and then slowly involute.

The onset of an attack is ushered in by constitutional symptoms, which are usually mild. These consist of fever, malaise, and pains in the muscles and joints. The nodules generally appear on the shins, first as erythematous spots beneath which the rather firm, tender, inflammatory nodules may be felt, and later as raised, rounded, painful scarlet swellings. The lesions are, as a rule, multiple, varying in number from two to six, and are symmetrical. Other areas besides the anterior tibial region may be involved, particularly the extensor aspects of the arms. The development of the lesions is rapid and after they reach full growth they gradually involute spontaneously, but due to the appearance of fresh lesions the course of the affection may be extended over several weeks. Probably several causes may provoke the disorder.

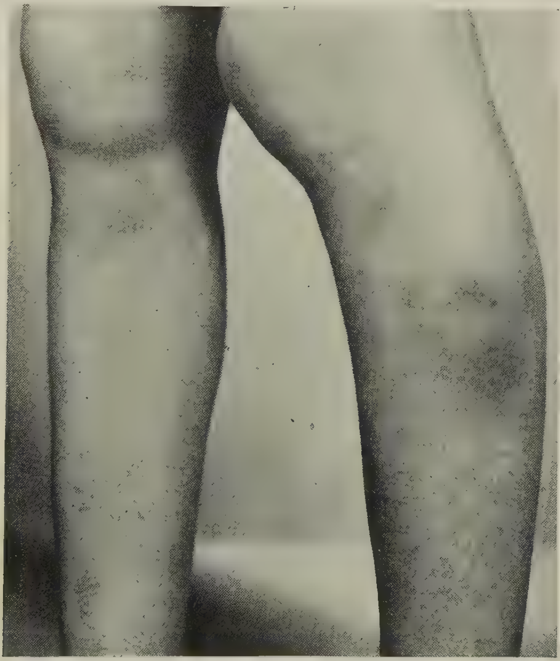

Fig. 209.—Erythema nodosum.

Erythema nodosum is often associated with rheumatism, septic sore throat, tuberculosis, or the ingestion of drugs, especially iodides and bromides. Early cases of erythema induratum may resemble erythema nodosum so closely that differential diagnosis is difficult, although the microscopical findings are of considerable assistance. Erythema induratum usually affects the calves of the legs, and runs a slower course, with likelihood of ulceration.

Syphilitic gummas, as well as the nodules of sporotrichosis, are, as a rule, unilateral.

The treatment indicated for erythema multiforme is advisable. In addition, salicylates *per os* or intravenously are of significant value. Dry heat from an incandescent bulb or thermolite applied for twenty minutes twice daily often relieves the discomfort and favors involution. I used medical diathermy with benefit in one case of erythema nodosum. Fractional x-ray treatment is sometimes beneficial. All topical applications should be combined with rest and supportive treatment of the affected parts.

URTICARIA

Synonyms.—Hives, nettle rash, cnidosis.

Urticaria is an inflammatory affection characterized by the appearance of wheals which are whitish or reddish evanescent, slightly elevated papules, macules, patches or streaks (welts), generally surrounded by a halo and associated with itching, stinging, or pricking sensations. The eruption usually favors the covered areas, such as the trunk, buttocks or chest, although other parts may be affected. Tissues other than the skin may be involved, which gives rise to symptoms such as coryza, asthma, and abdominal pain.

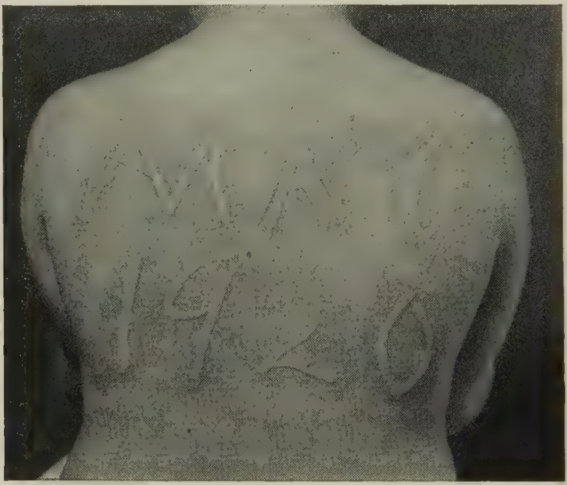

Fig. 210.—Dermographism. (Courtesy of Dr. Benjamin F. Ochs.)

Types.—Several varieties of urticaria are recognized. The commonest is characterized by wheals which are usually pruritic. These come out in one or two regions, last a few hours, and disappear but are likely to recur. More severe cases have a generalized distribution, and due to coalescence large edematous plaques may be formed. In addition there may be a swelling of the dependent and distensible parts. The attacks are usually of sudden onset and of short duration. In chronic urticaria, which is uncommon, a fresh outbreak of efflorescences continues to appear from day to day and from week to week, sometimes lasting almost indefinitely, and in rare instances the lesions instead of being evanescent persist for days or even weeks.

Papular urticaria, also called prurigo simplex, lichen urticatus, and strophulus pruriginosus, is a type in which the individual lesions consist of tiny deep-red papules, which are at first surrounded by pinkish blotches about 1 cm. in diameter. At the end of four to twelve hours the blotch disappears, leaving the papule. When the lesions are scratched the excoriations may be followed by pigmented stains. The disease is common among children, in whom it occurs chiefly on the face, extremities, and buttocks, being usually of gastro-intestinal origin.

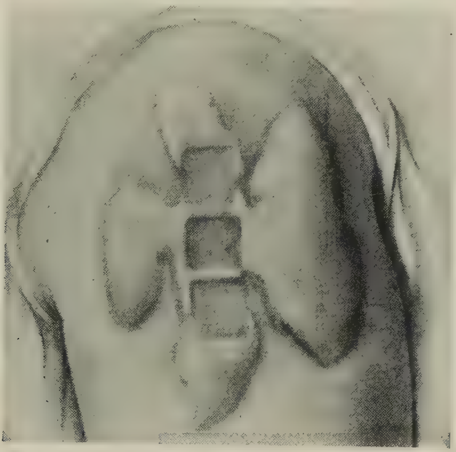

Fig. 211.—Urticaria solaris. Large area of itching edema which appeared in five and one-half minutes after exposure of the skin to sunlight for two and one-half minutes. The irregularities in the figure were due to a shadow cast by the hands holding three pieces of square colored glass in contact with the skin. The shape of the shadow cast by the hands was modified slightly by the artist to illustrate better how closely the edema followed the outlines of the colored glass. The edema did not spread beyond the area exposed to light. Sensitiveness in this patient increased at a later date, so that a thirty-second exposure sufficed to produce a severe reaction. General symptoms were felt when a large area of skin was exposed. After subsidence of the reaction, further exposure of the area to light on the same day produced less or no reaction. Frequent exposure of an area gave rise to local tolerance for light, which lasted several days. (Courtesy of Dr. W. W. Duke.)

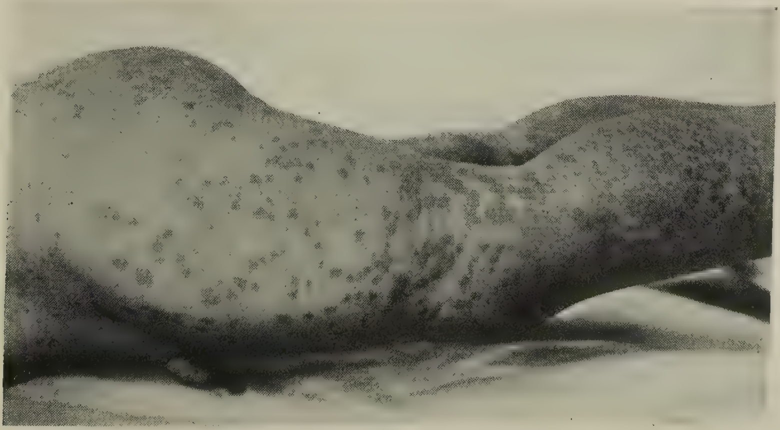

Fig. 212.—Urticaria. Papular type.

The bullous variety also occurs mostly in children, and is characterized by the sudden outbreak of vesicles or bullae, each lesion being surrounded by a zone of hyperemia. A hemorrhagic variety is rarely seen in connection with grave visceral disease.

Factitious urticaria is a condition of the skin in which wheals are produced by rubbing, pinching or scratching, instead of coming out spontaneously. In this type there is a cutaneous vasomotor instability which produces a hypersensitiveness to any irritation. The condition is common in a mild degree in many itching skin diseases and in toxic or nervous states. When present, a scratch may provoke a linear, raised, pale streak bordered on each side by a hyperemic line, so that it is possible to write upon the skin by scratching it with a dull instrument. This condition is called *dermographism.*

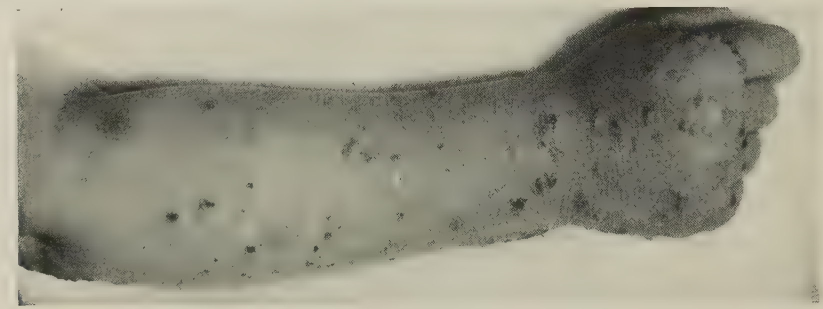

Fig. 213.—Papular urticaria. Similar lesions were upon the legs. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Giant urticaria is a variant form of urticaria resembling angioneurotic edema, in which there are large circumscribed, deep, edematous swellings. It is differentiated from erysipelas by the minor character of the systemic symptoms, the rapid onset, and small amount of local inflammation. At times, giant urticaria is combined with wheals and the swelling appears in different parts of the body in succession, being known as migratory or wandering edema.

Etiology.—Urticaria, like erythema, may result from both external or internal factors, or may occur in the course of various skin affections—scabies, drug eruptions, dermatitis herpetiformis, erythema multiforme, lymphoblastomas, *et cetera.* Insect bites, plant poisons, sunlight, cold, heat, and physical or mental exertion occasionally produce urticarial eruptions. Toxins from the gastro-intestinal tract, anaphylaxis to certain foods, drugs, and bacterial proteins or serums are the most common internal causes of this manifestation. The outbreak may be accompanied or preceded by symptoms of gastric derangement and, in markedly acute cases, by some fever.

Intracutaneous and subcutaneous tests with various foods, pollens, epidermal and bacterial proteins are made in persistent or recurrent cases of urticaria, in prurigo, dermatitis herpetiformis, and in eczema. Whereas the results of such tests are not in themselves sufficiently reliable to warrant a conclusion as to the etiology of the disease, they may arouse a suspicion of the cause and thus be of some assistance.

The intracutaneous tests are usually made by the scratch method. A separate scratch is made for each substance tested and in addition a control scratch is made to prove the harmlessness of the decinormal sodium hydroxide solution which is used for dissolving the test substances. As a rule, the lower back or the anterior surface of the thigh is chosen for the scratches. These are made $\frac{1}{2}$ inch long with a pointed scalpel through the epidermis, without causing any bleeding. As each scratch is finished a few drops of decinormal sodium hydroxide solution are placed upon it and into this a bit of the test substance is dropped, the two then being mixed with a clean toothpick. As many as one hundred tests may be made at a sitting. The test substances are left on for thirty minutes, after which they are rinsed off with sterile water and the skin is dried.

Readings are then made, first of the control scratch, which had only decinormal sodium hydroxide solution applied to it, and then of the others. Positive reactions consist of wheals, dime sized or larger. Occasionally instead of a wheal simply an erythematous spot will become evident, or there may be no erythema and only a rounded swelling of the skin. Rarely an edematous plaque, several centimeters across, will appear and even develop into a generalized but transient erythema. In this event there may supervene systemic symptoms such as nausea, a chilly feeling, a flush, and dyspnea. Negative results are those in which the scratch mark, after removal of the test substance, shows little or no change. The patient is instructed to observe the test region throughout the next day for possible tardy reactions. All tests should be repeated three or four times at intervals of a couple of weeks before the results are compiled, and then, as stated, the positive tests may suggest a cause. Proof of the cause is given by actual trial. If possible, the suspected substance is eliminated from the patient's environment and then he is exposed to it freely, so that his response to its absence and presence may be studied.

It is also possible to do intracutaneous tests by using a hypodermic needle on a syringe. In this method no scratches are made. An aqueous solution of the test substance is introduced intradermally. This is accomplished by putting the skin under tension with the fingers of the one hand; the other hand sticking in the needle attached to the filled syringe, which is held parallel to the skin surface during insertion. About 0.2 cc. of the test substance, or sufficient amount to raise a small wheal is injected.

The results are read at the end of a half hour and also the following day. Meanwhile the patient is instructed to make note of any changes which become manifest. With this method of testing, positive reactions are similar to those obtained by the scratch technic except that the local reactions must be about twice as large as those of the scratch tests before they can be accepted as definite.

Subcutaneous tests are made in a manner similar to the above, but require strict asepsis. Positive reactions provoke inflammatory nodules that are painful and persist for several days, being one or even several centimeters in diameter. In addition to the nodules, the subcutaneous injections may produce diffuse redness and swelling of the region, and symptoms of general intoxication—headache, malaise, anorexia, and fever.

Each of these methods of testing has preference in the hands of some investigators. The injection methods are generally admitted to be the more dangerous and are believed by many to be the least reliable. It is possible that different methods are preferable for various substances.

Another technic which is used chiefly for testing the response of the skin to common external irritants, such as turpentine, paraphenylendiamine, or quinine solutions, and others, is called the patch test. The skin of a region to be tested is cleaned with alcohol and dried. Inch squares of gauze, three layers thick, are soaked in the test solutions and are strapped upon the skin with strips of adhesive plaster. These are left *in situ* for twenty-four hours and then removed. If the test solutions are irritating, either a wheal or a dermatitis may be formed beneath the gauze patch.

The following chart gives the substances which are included in routine tests, others being added as they are suggested by the history of the patient:

Apple
Asparagus
Banana
Barley
Bean
Beef
Beet
Blackberry
Bluefish
Buckwheat
Cabbage
Cantaloup
Casein
Celery
Cheese
Chicken
Clam
Cocoa
Cod fish

Coffee
Cow's milk
Crab
Cucumber
Duck
Glue
Grape
Grapefruit
Lamb
Lettuce
Lobster
Mackerel
Mustard
Mushroom
Oat
Orange
Paprika
Pea
Peach

Peanut
Pepper
Pineapple
Pork
Potato
Rhubarb
Rice
Rye
Salmon
Scallop
Shrimp
Spinach
Strawberry
Tea
Tobacco
Tomato
Veal
Wheat
Whole egg

Canary feathers
Cat hair
Chicken feathers
Cotton
Dog hair
Duck feathers
Goat hair
Goose feathers
Horse dander
Kapok
Muskrat
Orris root
Rabbit hair
Ragweed
Red fox
Sheep wool
Silk
Squirrel

Treatment.—In fresh outbreaks due to toxic poisoning, relief may be obtained by castor oil or an enema followed by a colonic irrigation with sodium bicarbonate. If the eruption has been present for some time, saline purgatives and alkalies given internally are beneficial. These are then followed by intestinal antiseptics, such as calomel and salol. The diet should be simple and especially low in proteins. Certain articles of food should be entirely avoided because they are known to be frequent causes of urticaria. The following diet is one I have frequently used:

Foods Not Allowed
- Fish
- Shellfish
- Eggs
- Meats (except lamb and poultry)
- Cheese
- Raw fruit (except oranges and grapefruit)
- Berries
- Tomatoes
- Pastries
- Canned foods
- Hors d'oeuvres
- Jellies
- Sweets
- Cocoa
- Cake

Liquids Not Allowed
- Gravies
- Salad dressing (except lemon and oil)
- Alcohol
- Vinegar
- Tea
- Coffee

Foods Permitted
- Milk and butter
- Cereals
- Poultry
- Lamb
- Breadstuffs
- Ice cream
- Other simple desserts
- Vegetables (see below) (cooked only)

Vegetables Permitted (must be cooked)
- Artichokes
- Beans
- Beets
- Broccoli
- Carrots (young)
- Celery
- Cucumber (baked)
- Dandelion greens
- Eggplant (stewed or grilled)
- Greens
- Lettuce
- Onions (boiled)
- Oyster-plant
- Peas
- Parsnips
- Pumpkins
- Rhubarb
- Sorrell
- Spinach
- Squash
- Swiss chard
- Vegetable marrow

Eat some kind of cooked fruit at every meal and no more than a small portion of poultry or lamb once a day.

Chronic urticaria is a most difficult disease to treat. Frequently these cases are baffling and require extreme diligence. A very thorough search should be made for the predisposing cause, which when found should be removed, or treated by suitable means. Dietary measures, elimination, general tonic treatment, and the removal of focal infections or emotional stresses are important procedures. Occasionally nonspecific protein injections of such substances as peptone, or typhoid, staphylococcus or streptococcus vaccines, or spleen liquid given over a long period of time cause gradual improvement.

Numerous internal remedies are used, especially in chronic urticaria; of these, ephedrine sulphate is the most valuable. For adults it should be given in doses 75 mg. t. i. d., p. c. The dosage for children is about 25 mg. t. i. d., the amount administered, in all cases, depending upon the body weight of the patient and the tone of the vascular system. The drug should be avoided in cases of hypertension, and care should be taken in its administration in view of the idiosyncrasy of some individuals. In the majority of cases of urticaria, however, the blood pressure is low, and when it is raised to normal the itching and skin lesions disappear. Ephedrine is superior to adrenalin, which given in doses of 3 to 40 minims hypodermatically sometimes aborts attacks. Doses may be repeated according to the patient's tolerance, but the drug should be used cautiously and stopped if it causes nervousness, palpitation, or throbbing in the head. Autohemotherapy is sometimes helpful in diminishing the intensity and frequency of the outbreaks. Twenty cubic centimeters of blood are withdrawn from the median basilic vein by means of a syringe and are injected intramuscularly into the buttocks. This procedure may be repeated twice weekly. As anaphylaxis is usually associated with a decrease in the blood calcium, calcium lactate and parathyroid extract orally are advised. Other remedies sometimes found effective are sodium bicarbonate, bromides, atropine, sodium salicylate, and salol.

Tepid or cold tub baths may be freely advocated. Their efficacy is increased by the addition of starch, sodium bicarbonate, phenol, sea salt, menthol, cornmeal, or gelatin.

Local antipruritic lotions containing phenol and liquor carbonis detergens, as well as innumerable other drugs, give relief. These may be presented as follows:

℞.	Phenolis	ʒj
	Mentholis	gr. x
	Calaminae praep.,	
	Zinci oxidi	āā ℥j
	Spt. vini rect.,	
	Glycerini	āā ℥ij
	Aquae hamamelidis	q.s. ad. ℥viij

M. and S. Anti-itching solution. Apply often enough to relieve itching.

℞.	Thymolis	gr. xv
	Glycerini	ʒij
	Spt. vini rect	℥iv
	Aquae destillat	q.s. ad. ℥viij

M. and S. Externally for itching.

℞.	Liquor. carbonis detergent	ʒj
	Tinct. benzoini composit	℥j
	Spt. camphorae	ʒj
	Spt. vini rect	℥iij
	Glycerini	℥j
	Aquae hamamelidis	q.s. ad. ℥viij

M. and S. Shake mixture. Apply for itching.

℞. Mentholis.. ℥j
Spt. vini rect..................................q.s. ad ℥iv

M. and S. ʒj to ʒij to bath tub of tepid water, for fifteen minutes, to relieve itching.

Iced compresses are also valuable, and occasionally dusting powders containing pulverized thymol or boric acid are soothing. Ointments and greasy applications are rarely beneficial.

Both ultraviolet light and *x*-rays have been used in all types of urticaria and in occasional cases some improvement has been reported. Usually they are not markedly efficacious.

URTICARIA PIGMENTOSA

Synonym.—Xanthelasmoidea.

This is a rare form of urticarial eruption, the lesions of which are more or less persistent and result in yellowish, brownish, or slate-colored stains. Three types are recognized: (1) The most common, which is characterized by pigmented macules and papules; (2) a nodular type, the rarest, in which yellowish nodules predominate and which in the beginning may be localized to one area; (3) a mixed type, in which macules, papules, and nodules are present. The disease usually appears in infancy or early childhood and subsides at puberty, although occasional eruptions are seen in adults. Itching may be present in varying degrees, and may continue after the lesions have disappeared.

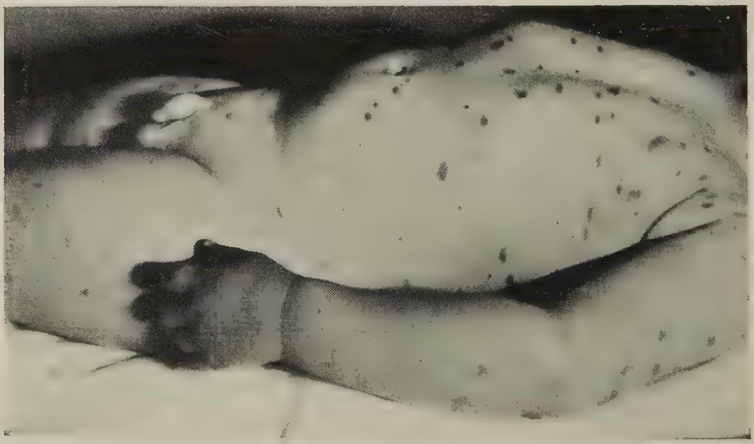

Fig. 214.—Urticaria pigmentosa. (Courtesy of Dr. Tryphosa R. Worcester.)

The disease apparently may begin with attacks of ordinary urticaria, or the first lesions noticed may be distinctly yellowish or slate colored. The areas of predilection are the trunk, upper arms, and thighs, but other sites may be affected. Some of the lesions are evanescent wheals, while others are persistent and slowly become chamois or slate colored. When they are rubbed a wheal may be produced about them. Frequently the lesions are slightly elevated and the nodules may be firm and discrete or confluent, and of a yellowish or brownish waxy appearance. Dermographism is occasionally present. In the course of time old lesions tend to disappear, leaving slightly atrophic spots, but the eruption is maintained by the development of new

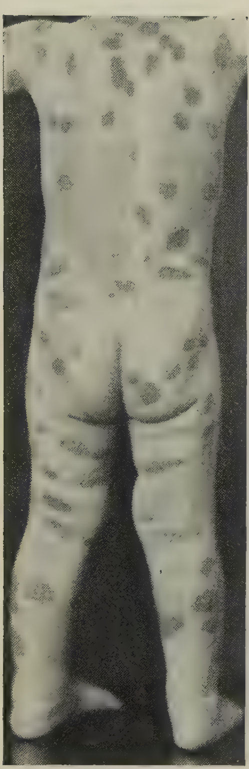

Fig. 215.—Urticaria pigmentosa. (Courtesy of Drs. J. B. and Bedford Shelmire.)

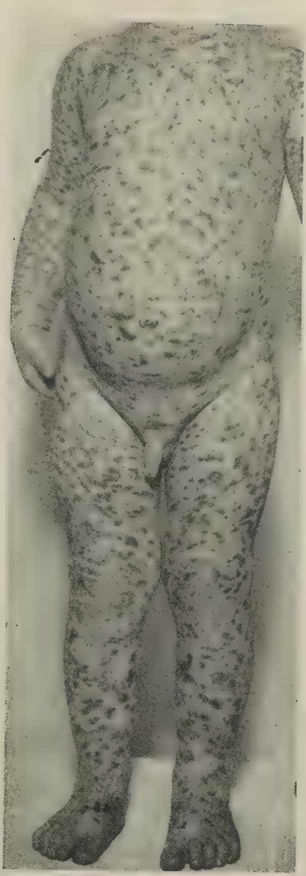

Fig. 216.—Urticaria pigmentosa. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

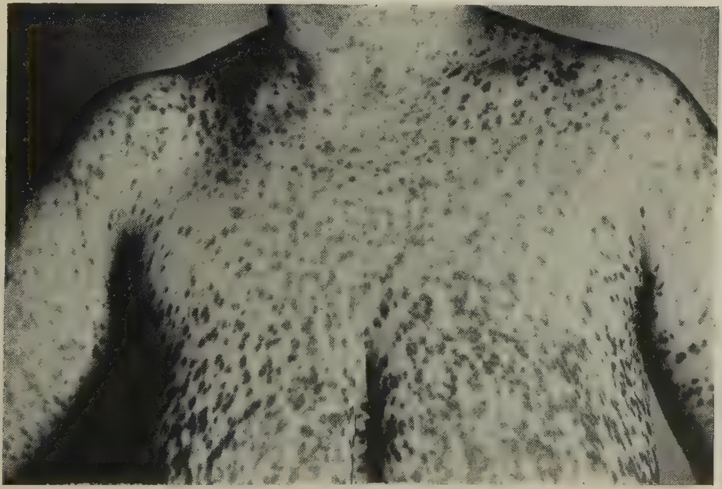

Fig. 217.—Urticaria pigmentosa in an adult.

lesions, with intermissions of comparative freedom from the disease. Fraser and Richter have concluded that mast cells may or may not be present in typical cases, depending presumably upon the stage of the lesion, as well as upon other undetermined factors.

The general plan of treatment should follow that described for urticaria. Studies should be made by intracutaneous tests with foodstuffs and bacterial proteins in an attempt to determine the causative factor. The diet should be carefully regulated and digestive disturbances should be treated. Local antipruritics should be applied if there is any itching.

Török and Schein have cited the cure of a patient with *x*-ray treatment. Michael has reported the involution of the eruption in a patient with an adult type of urticaria pigmentosa treated with *x*-rays. However, there was a recurrence in about a year. He mentioned 3 similar cases in the literature. Urticaria pigmentosa in infants was found by Hollander, associated with hyperplasia and persistence of the thymus gland. Following treatment with heavily filtered radium the eruption disappeared. Jacob, after treating a patient with three exposures of *x*-rays at intervals of a week, found no reaction. Although the eruption did not disappear, there was no further swelling of the lesions when irritated, and no new lesions, factitious urticaria, or itching. At a recurrence three months later another course of treatment afforded relief.

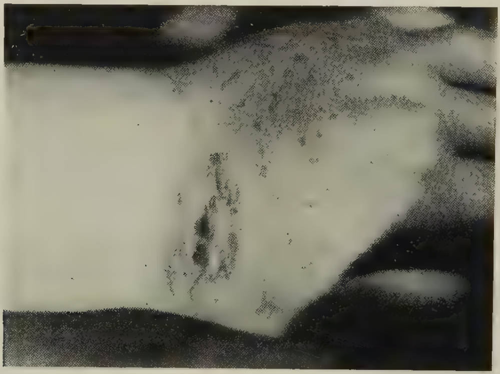

Fig. 218.—Urticaria pigmentosa, localized, nodular type, in a child. The lesions permanently regressed two weeks after suberythema dose of radium. (Courtesy of Dr. Paul Gross.)

Some improvement, especially relief of itching, has also followed roentgen therapy in the hands of others. From my observations I find that *x*-rays are certainly not a specific for this disease. But since the affection is so recalcitrant to other therapeutic measures, the improvement following treatment by roentgen rays is encouraging for their further use. Erythema doses are not warranted. Dr. Gross and I recently treated a patient with the localized variety successfully by a small dose of radium (200 mc. radon, screened with 0.5 mm. silver at 1 cm. distance for twenty minutes; surface area of applicator, 3 sq. cm.). The patch, which showed a typical histologic structure, disappeared completely as the result of this suberythema dose.

ANGIONEUROTIC EDEMA

Synonyms.—Acute circumscribed edema, Quincke's disease, Quincke's edema, giant swelling, giant urticaria.

There is an acute evanescent, circumscribed edema occurring concomitantly with urticarial lesions, and usually affecting the distensible tissues, such as the eyelids, lips, lobes of the ears, and external genitals, or the mucous membranes of the mouth, tongue, or digestive organs. The swelling occurs in the deeper parts of the skin or in the subcutaneous tissues and is usually circumscribed, but may be diffuse. The swellings, as a rule, are tender and the overlying skin is erythematous, although it may be unaltered, edematous, or rarely ecchymotic. On the hands, forearms, feet, and ankles, a diffuse swelling may take place. Frequently the condition begins during the night and is found upon awakening.

The affection generally results from gustatory indiscretions, and occasionally it is associated with febrile states or the ingestion of coal tar products. Due to the action of toxins there is a vasomotor lability which leads to sudden transudation from the vessels into the loose tissues. Cases of dietary origin are not infrequently due to the combined consumption of shellfish and champagne.

The treatment is similar to that described for urticaria. Colonic irrigations and saline laxatives and antacids, especially the bicarbonate, citrate, tartrate, and salicylate of sodium or potassium, have proved useful. Adrenalin given hypodermically or ephedrine orally is frequently very effective. In recurrent cases ultraviolet light has been used with some benefit. The exposures are given from a distance in daily suberythema doses over the affected areas. Locally, cracked ice or ice compresses or soothing lotions of lead or calamine give relief. When the throat is affected and breathing is obstructed, the sucking of ice, scarification, or intubation has been recommended.

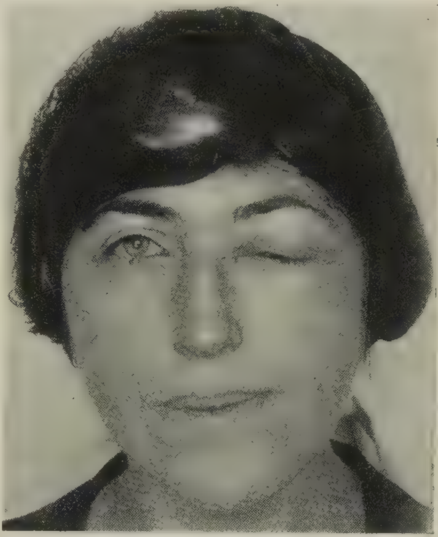

Fig. 219.—Angioneurotic edema. (Courtesy of Dr. Isaac R. Pels.)

PELLAGRA

Synonyms.—Erythema endemicum, Lombardian leprosy.

Pellagra is a deficiency disease of a chronic wasting nature which affects the alimentary tract, the nervous system, and the skin, where the eruption is probably due to the action of light. The evidence now available through the work of the United States Public Health Service seems to leave no reasonable doubt but that it is caused by a faulty diet and that the primary dietary defect is a deficiency of a vitamin, which has been designated by the symbol "P-P" (pellagra-preventive).

The disease occurs mostly in rural districts among the poor who eat an overabundance of cereal and an insufficient amount of animal protein, fruits, and vegetables. Alcoholism with a voluntary reduction of other substances in the diet produces the same symptoms.

The diagnosis of pellagra is often difficult until the disease is in an advanced stage, but is suggested by lack of strength, indigestion, headaches, nervousness, depression, and diarrhea, or a dermatitis which may be slight or absent.

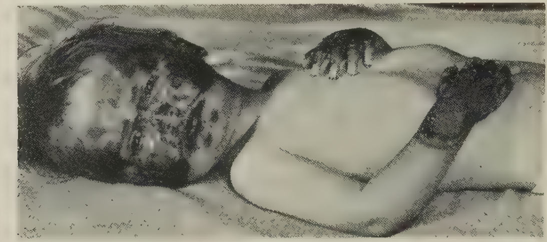

Fig. 220.—Typical pellagra in a child with lesions on the face and hands. (Courtesy of Dr. John A. McIntosh.)

The dermatitis occurs on the face, neck, wrists, and backs of the hands, presumably being due to the action of light upon photosensitive substances in the blood stream. The affected parts become brightly erythematous, with a distinct line of demarcation, which at the wrist is usually higher on the radial than on the ulnar side. The erythema may be accompanied by itching or burning, and at times there is thickening of the affected skin. After persistence of this condition for several weeks or months, the epidermis desquamates, leaving the parts deeply pigmented. In protracted cases the skin ultimately becomes atrophic. A brownish discoloration of the skin showing atrophy may be the only manifestation noted. The eruption has a tendency to be worse in the summer months, often disappearing in the winter and recurring each spring.

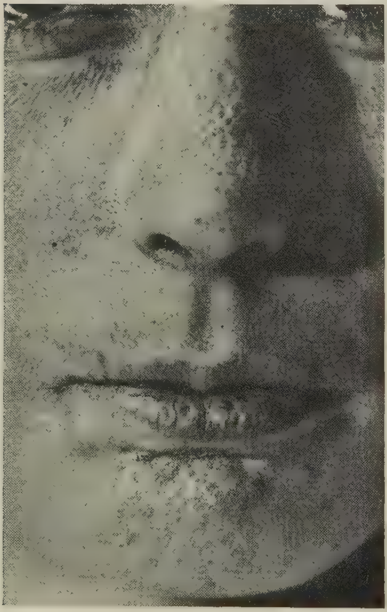

Fig. 221.—Pellagra. The nose and chin look as if they had been dusted with powder, due to a follicular keratosis. (Courtesy of Dr. Paul A. O'Leary.)

The pellagrin nose is fairly characteristic. There is a dull erythema of the bridge of the nose with a slight scaling, which resembles seborrheic dermatitis, except for its location. The scaling gives a powdery appearance so that the whole suggests a dull-red nose partly covered with powder. About the lower neck and extending to the sternal region there is likely to be a collarette of dermatitis similar to the eruption on the hands. The mucous membranes are affected by painful fissures and ulcerations and by a general tendency to atrophy. The lips and cheeks are thin and pale; the lips and mouth are dry, and the tongue smooth. Aphthous ulcers are commonly present and there is likely to be fissuring at the commissures. Similar changes may occur in the vagina.

There may be a swelling of the parotid glands, salivation, mental deterioration, tabetic symptoms, paralysis, or optic neuritis. The disease is progressive, the majority of patients dying in four or five years.

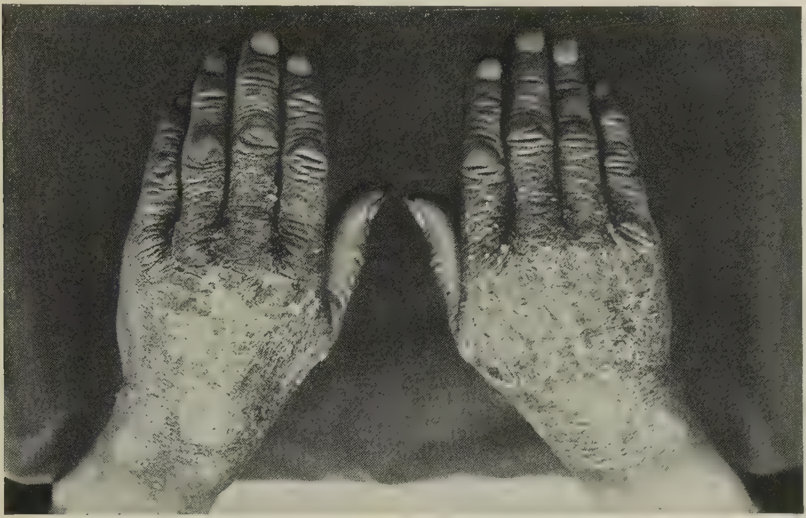

Fig. 222.—Postalcoholic dermatitis resembling pellagra. (Courtesy of Dr. A. Benson Cannon.)

Treatment.—A full diet, rich in vitamin P-P, which is similar to vitamins B and C, is prescribed. The carbohydrate content should be low, cane sugar being entirely eliminated. Foods which contain large amounts of vitamin P-P are: Milk, meat, and eggs. Brewers' yeast is an efficient remedy and should be given daily in doses of about two tablespoonfuls in either tomato juice or milk. In all but severe cases of pellagra careful feeding is all that is needed. It is only where such foods as fresh milk and fresh meat cannot be procured that yeast has much practical value. It is

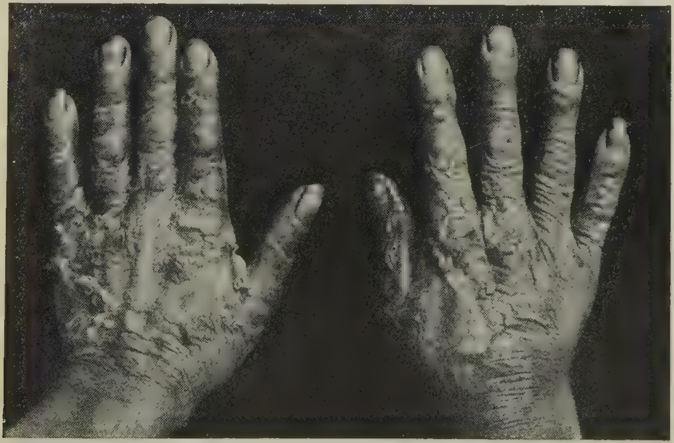

Fig. 223.—Pellagra. Desquamative stage. (Courtesy of Dr. Mihran B. Parounagian.)

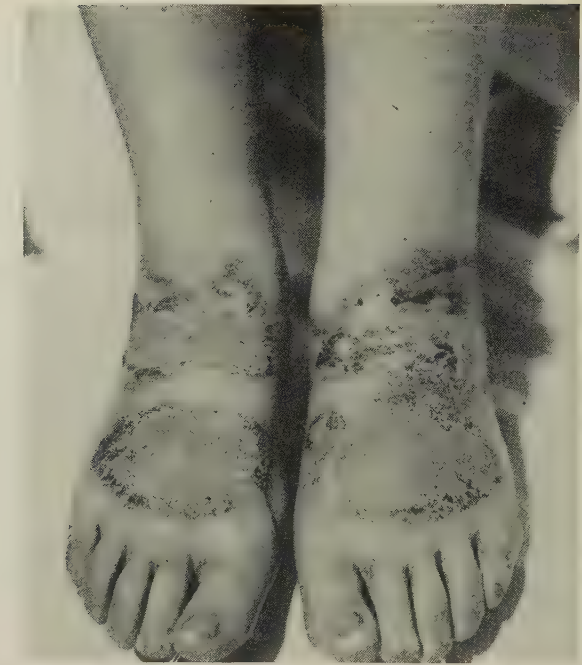

Fig. 224.—Pellagra in a strict vegetarian. Note uninvolved areas corresponding to outline of shoestrap and upper part of shoe, also tendency of eruption to involute in the center of the patch prior to the periphery. (Courtesy of Dr. Joseph V. Klauder.)

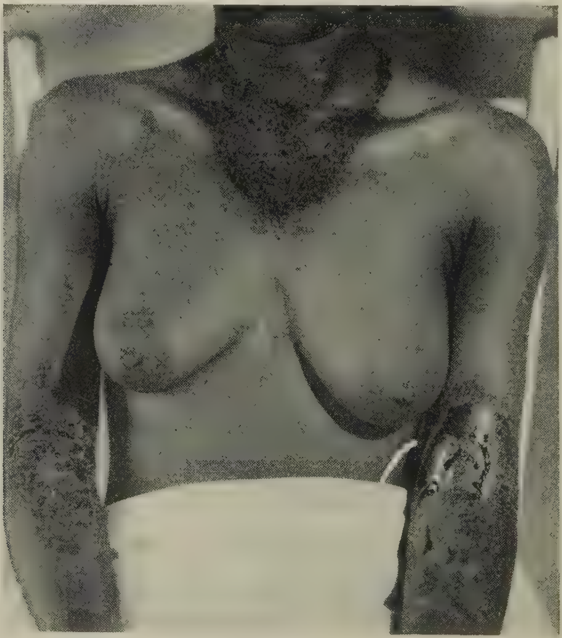

Fig. 225.—Pellagra, showing collarette (Courtesy of Drs. J. B. and Bedford Shelmire.)

advisable to give the patient all the meat he will eat, accompanied by ½ to 1 drachm of dilute hydrochloric acid in water, which is sipped during the meal. When the mouth is sore the meat should be scraped. In addition to eggs and sweet milk, buttermilk and vegetable purées are given. As the patient improves, olive oil, butter, malted milk with egg and cereals are allowed. Fresh beans and peas are especially recommended.

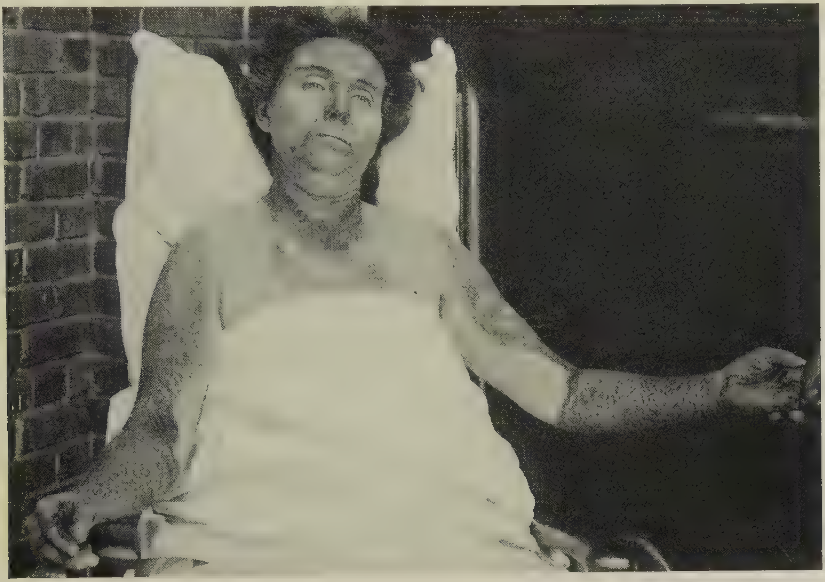

Fig. 226.—Pellagra. Widespread erythema. (Courtesy of Dr. J. J. Watson.)

Injections of sodium cacodylate are widely used. For the sores in the mouth and about the vagina, the most satisfactory treatment is by cleansing with Dobell's solution and then touching the ulcerations with silver nitrate. If there is salivation, atropine sulphate, 1/200 grain, may be given, and the other special symptoms should be treated according to the indications.

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CHAPTER XV

PRURITUS AND CUTANEOUS NEUROSES

PRURITUS

ITCHING, or pruritus, is a symptom rather than a disease. Although it regularly accompanies many skin diseases, the use of the term "pruritus" is conveniently limited to the essential incidence of itching without any apparent primary dermatitis. The disorder is purely subjective, may arise from internal or external cause, and may be localized or generalized. Pruritus always deserves most careful investigation, as it may be the first indication of serious internal disease—diabetes, leukemia, mycosis fungoides, carcinoma, and tuberculosis. Many cases are due to intestinal toxins involving putrefaction, fermentation, constipation, or toxemia, and stretching of the abdomen, associated with pregnancy (pruritus gestationis), arteriosclerosis or senility (pruritus senilis); others are the result of nervous, thyroid, renal, or hepatic disorders, the last being intensified when there is jaundice; a few are due to the ingestion of drugs and, more rarely, to reflex irritation from calculi. In some instances habit may form a large part of the affection. Among the numerous external causes are those of a chemical nature (disinfectants, insecticides, deodorants, dyestuffs, industrial irritants); sensitization (to plants, pollens, epidermal proteins), and physical changes (dryness—often from excessive use of soap—friction, constriction, lowered temperature).

In the beginning, pruritus is usually localized to one or two areas and it may remain so, may subside in one area and appear in another, or become generalized, the distribution being influenced by the cause. Itching of the scalp is generally provoked by excessive dryness, dandruff, or irritants in hair tonics. When there is itching of the nose, ears, eyelids, neck, or hands local predisposing causes may be dryness, seborrhea or external irritants (dyes and strong soaps). It should be remembered that a high blood icterus index, although insufficient to cause clinical jaundice, may produce intense pruritus. Pruritus hiemalis frequently affects the skin of the shins in the winter, and is made worse by woolen underwear, dyes of socks, cold water, and the use of soaps. The skin in the areas is likely to be dry, thin, and hairless, and sometimes lichenified. For the sake of convenience and clarity, the complicated subject of pruritus of the anus and genitals is discussed separately.

Vigorous and persistent scratching and rubbing in an effort to relieve the tormenting condition may cause objective symptoms such as scratch marks, erythematous blotches, blood crusts, fissures, wheals, and pigmentation. One of the most common effects of pruritus is the development of secondary changes in the skin called lichenification, due to rubbing or scratching. This condition is taken up under the heading Neurodermatitis.

Treatment.—Removal of the cause and breaking of the habit of scratching are necessary to give permanent cure. When internal toxins are the cause, treatment of the underlying organic disease and increase of elimination are important measures. As pointed out by Pollitzer, it is the class of cases in which toxic products are the result of gastro-intestinal disturbances that offers the best field for therapeutic efforts. Frequently, a radical change of diet will give benefit, and in the absence of specific indications a vegetable diet is often advantageous. Administration of Bacillus acidophilus orally or by implantation, stool vaccines, calomel, salol, colonic irrigations, and other gastro-intestinal treatment may be helpful.

As a rule, the skin should be protected against external contacts and temperature changes, which precipitate an attack. Woolen underclothing should be replaced by silk or cotton. Bathing should be regulated, as it may be harmful if ill-advised, or of therapeutic value. The bath water should contain sodium bicarbonate, bran, menthol, or other soothing agents, and should be tepid, starting at 78° F. and being reduced gradually to 68° F., or should be followed by a cold spray. The skin should be dried by patting with a soft hand-towel and covered with a powder, suspension, or cream.

The relief of the itching is indicated. This is accomplished by local remedies, of which phenol is the most important. Its usual strength in lotions is 2 per cent, although as high as 5 per cent may be incorporated. In ointments the strength varies from 1 to 10 per cent, being generally 3 per cent. Care must be exercised in the use of even weak phenol preparations as they may induce gangrene or, if applied to extensive areas, cause toxic effects from absorption.

The antipruritic action of menthol is largely due to its cooling properties and it is one of the drugs commonly employed. It is used in strengths of ¼ to ½ per cent in alcoholic lotions, and 1 to 20 per cent in ointments, usually in lotions.

Liquor carbonis detergens is an excellent antipruritic when added to lotions in strengths of 2 to 8 per cent. Alcohol is necessary in the mixture in order to produce a solution.

Cocaine is a dangerous antipruritic drug, which may at times be required, the hydrochloride being used in a cream in strength of 1 to 2 per cent. It may be applied only to small areas for a day or two while the patient is under nursing care.

Cresol has properties similar to phenol and is used in the same dosage. Chloroform is a potent antipruritic, but is liable to cause irritation if prescribed injudiciously. It should be ordered only for small areas in strengths of ¼ to ½ per cent in an ointment base. It is preferably used in combination with cresol, phenol, menthol, or camphor, the latter in strengths from 2 to 10 per cent. Thymol is a good antipruritic, but is likely to irritate the skin. It is used in lotions in strengths ranging from ½ to 2 per cent. Hydrocyanic acid, tincture of benzoin, chloral, resorcin, olive oil, alcohol, acetic acid, and zonite are other antipruritics.

The following formulas are suggested for generalized pruritus. For localized pruritus reference should be made to measures of treatment described for pruritus ani.

℞.	Phenolis	ʒss
	Mentholis	gr. v
	Adipis lanae,	
	Ung. aquae rosae,	
	Ol. cocoanut,	
	Tragacanthae	āā ʒij
	Sodii boratis	ʒij
	Ol. amygdalae amarae	gtt. xv
	Aquae hamamelidis	q.s. ad. ℥iv

Gradually add the hamamelis with constant stirring until a thick paste is obtained, when it can be added in quantity.

S. For generalized pruritus.

℞.	Emuls. amygdalae	℥iss
	Emuls. tragacanthae	℥ij
	Glycerini	℥j
	Aquae hamamelidis	℥j
	Mentholis	gr. iij
	Spts. vini rectif.	ʒj
	Ol. lavandulae	gtt. xv

M. and S. For generalized pruritus.

℞.	Liq. carbonis detergent	ʒss
	Liq. alumini acetatis	℥ij
	Petrolati liquidi	℥iiss
	Cerae albae	ʒiv
	Sodii boratis	gr. xx
	Aquae dest	℥iiss

M. and S. Antipruritic cream for extensive surfaces.

Benacol is a reliable and effective drug for the relief of localized pruritus. I highly recommend it in recalcitrant cases, and describe its chemical composition and the technic of its administration under pruritus ani.

The sedative action of roentgen rays is one of the most effective forms of relief for pruritus. One fourth of an erythema dose, unfiltered, often gives complete relief in a few hours or days after the first exposure, but may be repeated once weekly. In some instances radicular radiotherapy is beneficial when all local measures have failed.

Generalized ultraviolet radiation in suberythema doses given daily may afford striking and immediate relief of widespread itching. At other times, in pruritus senilis and pruritus hiemalis, the benefit is more gradual, apparently being parallel with tanning. In the treatment of localized pruritus, actinotherapy also improves the condition, but the results are inferior to those from roentgen rays.

In pruritus hiemalis, treatment is largely internal—by building up the general health and increasing the elimination, and by the avoidance of soap upon the legs. The itching may be relieved by local antipruritics as described under pruritus ani or by a few fractional doses of *x*-rays.

Pruritus Ani, Vulvae et Scroti.—Pruritus ani and pruritus of the genitals, like other forms of localized pruritus, are characterized by crises which occur more or less periodically. The condition may be divided into two varieties: the one of purely local origin, and the other indirectly provoked by constitutional, toxic, or reflex causes. The pruritic area about the anus and genitals is supplied by sensory filaments from the plexus pudendus from L. 5, S. 1, S. 2, S. 3, S. 4 segments, through the N. pudendus and N. perineus, whose terminal filaments (N. hemorrhoidalis inf., N. labialis posterior) anastomose with rami from the N. cutaneus femoris posterior. The local sensory nerves are connected with the visceral innervation through the hypogastric and aortic plexuses. Rarely, however, do the cutaneous pruritic manifestations correspond with the supply of any one nerve.

Etiology.—The causes of pruritus of the anus and genitals are so manifold that a thorough physical examination is necessary for intelligent treatment. The etiology is further complicated by the fact that indirect pruritus, although devoid of local pathology at its inception, rapidly, as the result of scratching, induces local skin changes, which themselves produce itching. In this variety of pruritus local treatment may relieve the itching and scratching, but unless the underlying causes are eliminated no permanent relief is obtained. Even when the condition is of purely local etiology it may be aggravated by constitutional derangements, especially nervousness and toxic states. When lesions are of long duration, habit assumes such a large rôle in a continuation of the disease that it must be combated by training.

The prominent causes are:

Local

- Irritants:
  - Cathartics
  - Toilet paper
  - Tight clothing
  - (See additional ones given under eczema)
- Parasites:
  - Colon bacillus
  - Fungi (E. cruris, E. rubrum, yeasts)
  - Intestinal parasites (including Amoebae)
  - Staphylococcus aureus (possibly also the causative agent of seborrheic dermatitis).
  - Streptococcus fecalis
- Conditions:
  - Cryptitis
  - Fissure
  - Fistula
  - Hemorrhoids
  - Hypertrophied papillae
  - Polypus
  - Proctitis
  - Spastic sphincter
  - Skin tags
  - Ulcers

Constitutional or Reflex

- Anemias
- Exophthalmic goiter
- Diabetes
- Neurotic habits
- Menopause
- Pregnancy[1]
- Lithiasis

- Alimentary disorders (especially constipation, fermentation, putrefaction, colitis, carcinoma, cirrhosis of liver, cholecystitis).
- Genito-urinary diseases (nephritis, prostatitis, cystitis, posterior urethritis, vesiculitis, endometritis, or diseases of other pelvic structures).

Pruritus ani of mycotic origin has no special clinical characteristics and is diagnosed only by microscopical examination of scrapings from the affected parts. Examination should also be made of suspected lesions between toes or of the nails. In some cases Monilia and other yeastlike organisms are found and in others the Epidermophyton occurs.

A study of the pathology of pruritus ani, vulvae et scroti shows no essential differences between the direct and the indirect varieties of the conditions when they are well established. The changes are divided into two main phases, to which may be added a third, less frequent and, from a clinical standpoint, a less important one. In the first phase there is the picture of a chronic productive dermatitis of traumatic origin; in the second, that of a subacute exudative dermatitis of probably infective origin, which is frequently superimposed upon the manifestations of the first. The changes in the third phase consist of an extensive atrophy of all parts of the skin of the affected area.

Treatment.—Naturally, there are manifold, more or less specific forms of therapy for a recalcitrant condition which arises from so many causes. In addition to these and to constitutional measures, there are physical and surgical procedures which are employed empirically. In the former group are included local remedies (antiparasitic, antipruritic, anesthetic, stimulating or caustic), heat in the form of douches, sitz baths, hot compresses, or hot air, tonic measures, vaccine injections, autohemotherapy, bromides intravenously, alcohol or benacol injections, lumbar puncture, and psychotherapy.

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[1] Vulvar pruritus may denote toxicity. In one case of suspected pregnancy too early to be diagnosed by the obstetrician it persisted violently for four weeks. Then a hemorrhage followed by curettage revealed a mummified fetus. The blood count in this patient showed 14,000 total leukocytes, 70 per cent polynuclears, and 14 per cent eosinophils. The itching disappeared permanently within a few hours after the curettage.

In all cases the following directions are of value:

Avoid fluid movements. Use soft cellulose tissue or cotton instead of toilet paper. After the bowels move, cleanse the anus with cotton and olive oil or warm water without rubbing. Do not use soap and keep fingers away from the part as much as possible. Whenever itching is severe, apply anti-itching medicine instead of scratching. Use salve regularly morning and night and before or after the bowels move. Hard movements should be softened by the ingestion of plenty of fluids and, if necessary, liquid petrolatum, although to the latter irritating properties have been occasionally ascribed. Clothing should be light and loose, and contacts caused by prolonged sitting, or sleeping on the back should be avoided.

Diet should be bland and nonirritating in accordance with the following suggestions:

Beverages not allowed:
- Tea
- Coffee
- Alcohol
- Allowed 1 cup of warm (not hot) coffee or tea at breakfast

Foods not allowed:
- Spices
- Gravies
- Condiments
- Rich foods
- Rich sauces
- Hot soups
- Hot foods
- Hot drinks
- Sweets

Allowed breadstuffs, cereals, dairy products, ice cream, milk and egg desserts and other simple desserts.

Especially advised:
- Vegetable diet and allowed small portion of meat once daily.
- Fruits cooked without sugar.
- Foods may be warm but never hot.
- It is better to eat small amounts often, avoiding large meals.

Of the innumerable remedies the following formulas have given the best results in my hands:

℞.	Phenolis	ʒss
	Mentholis	gr. v
	Glyceriti acidi tannici	℥iv

M. and S. Apply on cotton to allay itching.

℞.	Phenolis	ʒss
	Mentholis	gr. v
	Bismuthi subcarb	gr. xv
	Zinci oxidi,	
	Glycerini ... āā	℥ss
	Aq. camphorae ... q.s. ad.	℥iv

M. and S. Apply often enough to allay itching.

℞.	Phenolis	ʒiv
	Camphorae	ʒvi
	Spts. vini rect ... q.s. ad.	℥iij

M. and S. Apply on cotton to relieve itching.

℞.	Camphorae,	
	Phenolis ... āā	ʒss
	Cocainae hydrochloridi	ʒj
	Liq. alumini acetatis	℥j
	Cerae albae	ʒiij
	Petrolati (heavy)	℥iiss
	Sodii boratis	gr. xx
	Aquae	℥j

M. and S. Sedative cream.

℞.	Glycerini	℥j
	Mentholis	gr. x
	Phenolis	ʒj
	Mucil. chondri ... q.s. ad.	℥viij

M. and S. Soothing lotion.

℞.	Ac. salicylic	gr. xx
	Ac. benzoic	ʒss
	Sulphur praecipitat	gr. xx
	Ol. theobromatis,	
	Boroglycerin	āā ʒj
	Adipis lanae hydros	q.s. ad. ℥j

M. and S. For the mycotic type of pruritus ani.

℞.	Chloroformi	gtt. ij
	Phenolis,	
	Mentholis	āā gr. x
	Adipis benzoinati	q.s. ad. ℥j

M. and S. Apply locally.

℞.	Balsami peruviani	ʒj
	Cresolis	gtt. x
	Adipis lanae,	
	Petrolat. albi	āā q.s. ad. ℥j

M. and S. For fissured types.

℞.	Resorcinolis,	
	Phenolis	āā gr. x
	Ol. cadini	gtt. xx
	Bismuthi subnitratis	gr. xv
	Ol. olivae	gtt. xv
	Adipis lanae	q.s. ad. ℥j

M. and S. Apply locally for itching.

Daily treatments by painting with silver nitrate solution, 10 to 50 per cent, or balsam of Peru are advisable in cases of fissures or indolent ulcerations, and in mycotic conditions diluted tincture of iodine is applied in a similar manner.

In the mycotic variety of pruritus ani and pruritus vulvae treatment is by the use of antiparasitic remedies and at times by roentgenotherapy. Of the former those chiefly used are sulphur and salicylic acid, each 2 per cent in lanolin, or Deeks' ointment, which consists of salicylic acid, mercury salicylate, and oil of eucalyptus, each four parts, bismuth subnitrate, ten parts in a mixture of lanolin and petrolatum up to 100 parts. Castellani also recommends a paint of the following formula: carbolfuchsin as used for staining tubercle bacilli, 100 cc.; boric acid, 1 Gm.; acetone, 5 cc.; and resorcinol, 10 Gm.

Alcohol injections subcutaneously are given under general anesthesia with nitrous oxide or ethylene gas, the method being quickly performed during a short stay in the hospital and without dressings. The patient is placed in the lithotomy position, the area prepared with iodine and alcohol, and injections of 95 per cent grain alcohol are made just beneath the involved skin by means of an ordinary small hypodermic syringe and a fine needle not over 1 inch long. The needle is plunged vertically entirely through the skin, and no more than 2 to 3 minims are given in each puncture. The punctures should be spaced about ¼ inch apart until the whole area is "stippled," and they should be carried to about ¼ inch from the anal margin but not in the anal canal. The scrotum, labia majora, and folds of the groins have been injected without difficulty. Blood vessels should be avoided if possible. In case of a recurrence, after six months or more the procedure may be repeated. Rice has reported 100 cases of pruritus ani treated by alcohol injections. The results may be lasting and are equally good in pruritus vulvae and pruritus scroti. According to Stone, over 200 injections have been given during the past ten years at the Johns Hopkins Hospital. His conclusions are that, although few are permanently cured, many have relief for several years, the majority being free from symptoms from six to twelve months, when the itching tends to recur but usually in a less intense form.

Benacol is also given by injection. The solution consists of equal parts of para-aminobenzoyl ethanol benzoate and phenmethylol in 90 parts of rectified sweet almond oil. It affords immediate relief from the itching in the injected area, with a minimum of pain. The relief has lasted from several weeks to four months in the hands of Yeomans, Gorsch, and Mathesheimer, who have used the method most, and in some of my cases it has given a complete cure. The drug is nontoxic, highly anesthetic, moderately antiseptic, and is believed to have a mild depressant action on peripheral nerve endings. The injections require no preliminary anesthesia, causing but little pain if given slowly. They are made beneath the skin and mucocutaneous junction of the perianal region, and distributed as evenly as possible in order to avoid small areas of necrosis. The injections are repeated a few times at intervals of two to three days, about 1 cc. being given at each treatment.

The careful use of autogenous vaccines will give gratifying results, but other forms tend to bring into disrepute a truly useful therapeutic agent. The injections should be combined with the surgical treatment of local abnormalities when they are present, as otherwise the results will be temporary. The value of the use of autogenous vaccines is confirmed by the work of Winfield and Murray, Knowles and Corson, Schamberg, Alderman, Saphir and others.

Many operative procedures have been employed for the treatment of pruritus ani, all having as their foundation the severance of the nerve fibers which supply the zone. The operations are of the undercutting type, the flaps being separated by packing as long as possible afterward to give the maximum local anesthesia. Although surgical excision of the involved skin and various undercutting and dissecting operations have been used over twenty years, none has met with general approval or even moderate success, as the relief is temporary except in the few cases where excision of diseased tissue or the psychotherapy of the operation is sufficient to cure permanently. Any one who has experienced an extensive undercutting operation of this region knows that the postoperative pain is so severe that it will forcibly control all local pruritus for an extended period of time and in some persons, as before stated, there is even a permanent cure. No feasible means have been suggested for preventing the reunion of the severed nerve ends, or the growth of new sensory filaments distally. In fact, the propriety of operative treatments based upon the attainment of anesthesia through the severance of sensory nerve fibers to this area is challenged by the absence of any histologic or clinical proof that the cut nerves do not reunite and function as cut nerves do in other parts of the body.

Although upon an insecure physiologic foundation, surgical treatment of pruritus ani has been advocated by many able men. Frankenthal believes that a surgical excision of the involved skin and resection of the perineal nerves is a most successful treatment. He uses similar surgical treatment of pruritus vulvae, resecting the posterior labial nerves. Others have claimed success from operative treatment and have described many variations in the method. Wallis has reported that 90 per cent of 272 patients were cured by the use of the actual cautery.

The physiotherapeutic methods include the *x*-rays, *w*-rays, and ultraviolet rays, radium, and iontophoresis, of which the *x*-rays are of outstanding importance. Whereas the indications for irradiation are largely empirical, the results in general show that pruritus due to local causes such as inflammation responds better than that of nervous origin, which cannot be relieved as frequently. However, when the symptom is due to a reflex or constitutional cause, the application sometimes gives relief that cannot be obtained by any other method. The use of radiation should always be combined with other more specific measures directed at the cause.

x-Rays.—Two methods of roentgen-ray exposure have value, the one, local[1]; the other, radicular. Local treatment is carried on by fractional exposures of either unfiltered or filtered rays, both of which have, in my experience, given equally good results. Because of differences in the construction of individuals the position of the patient during the *x*-ray exposure must be varied to suit the particular case. In some the knee-chest position gives the best exposure of the anus. Those who are obese may aid exposure by holding the buttocks apart with their hands, in which event the hands should be carefully shielded with lead. When this is not feasible, the buttocks may be held apart by straps of adhesive tape which extend from the anal margin to the abdomen. In the thinner type of individual the area is occasionally exposed best in the prone position, by pulling the buttocks apart with adhesive attached to the sides of the table. When the pruritus extends from the anus to the perineum, the lithotomy position with the patient on the back and the thighs flexed on the abdomen sometimes gives the best exposure. In this position, caution must be observed in the shielding of the inner surfaces of the thighs. In the obese it may be desirable to make two exposures, one on the perineum in the lithotomy position, and the other on the anus in the knee-chest position. Overlapping is permitted, but care must be exercised not to overirradiate by this method. The focus of the two exposures should be nearly at right angles, with a distance of 8 or 9 inches between the points upon which focus is made. Sjogren has devised a high wooden stool with an oval opening 9 by 14 cm., over which the patient sits. The tube is below, and between it and the scrotum and thighs is a sheet of lead 2 mm. thick.

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[1] See also Technic, Chapter XVI, p. 410.

The vulva is most conveniently irradiated in a lithotomy position. The thighs should be separated as much as possible, and exposure of the vulva is increased by elevating the hips 8 to 10 inches on pillows. When the thighs cannot be widely separated, the skin-anode distance must be increased with the corresponding increase of exposure time according to the law of the inverse square. The distance between the tube and the vulva should always be less than between the tube and the inner surfaces of the thighs, which should be carefully protected by lead. When the pruritus is within the labia, it is advisable for these to be separated either by adhesive straps or by the patient's fingers. In the latter case the skin-anode distance should be measured from the hand, or fingers if they are nearer to the tube than the vulva, and the exposed fingers should be shielded.

With unfiltered radiation the dosage is usually $\frac{1}{4}$ E. D. at weekly intervals, or a full skin dose may be given monthly, always being kept below an erythema. Another method of administration which perhaps expedites recovery is to start with $\frac{1}{2}$ E. D. and to give $\frac{1}{3}$ E. D. five days later, and then after an interval of seven days to give $\frac{1}{4}$ E. D. Following a rest of two weeks the radiation is continued with $\frac{1}{4}$ E. D. weekly.

In recalcitrant cases associated with pathologic conditions in the deep urethra, prostate gland, or vagina, filtered technic is indicated. The dosage is fractional and is kept below an erythema. One third E. D. given every ten days for a total of three treatments should be followed by an interval of a month, after which the course may be repeated. This gives a maximum dosage, which is sometimes curative when other technic has failed. Relief from itching is usually noted after the third or fourth filtered dose. In recalcitrant cases, after repeated treatment, pigmentation or epilation may ensue. The latter serves as an indication for a cessation of therapy for at least two months.

Radicular radiotherapy or the irradiation of the spinal ganglia of the segments supplying sensory filaments to the pruritic zone has been successfully used by a number of observers. The technic has been already described. In my experience the method has been only occasionally beneficial in cases of the indirect type.

When *x*-ray treatment is evoking a response, usually only a few exposures are needed, for which reason the giving of a large number is deprecated. When the treatment is successful, the cure is generally permanent.

In all exposures the testicles should be shielded with sheet-lead at least $\frac{1}{8}$ inch thick; and with such precautions no deleterious effects on the genitals have been observed. However, when pruritus of the scrotum is being treated with *x*-rays there is always the danger of causing some damage to the testes. The amount of *x*-rays which it is safe to administer to the scrotum is unknown. The generative cells are so highly sensitive to radiation that even small quantities are theoretically dangerous. In spite of this fact the suffering in refractory cases of pruritus scroti has led to the frequent use of *x*-rays for relief and only rarely have injuries been noted, which may be explained by the lack of careful examinations. In general, preference should be given to other methods, especially to treatment by the *w*-rays or unfiltered radium.

w-Rays.—The *w*-rays effectively control localized pruritus, being especially indicated on the scrotum because of their low penetration. I have also used them successfully on patients with long-standing anal pruritus which has not responded to other forms of radiotherapy. The technic is as follows: The pruritic area of skin is flattened as much as possible and exposed at a short skin focus distance, usually 2 cm. from the glass window of the tube. Sharp reactions to the very soft rays thus applied should be avoided. As a rule, I use 8 kv., 8 ma., at this distance for four minutes weekly. One treatment is generally sufficient to give relief.

Ultraviolet Light.—The sedative and bactericidal actions of ultraviolet light have proved efficacious in the treatment of localized pruritus in the hands of many, but my own experience with it for such purpose has only occasionally warranted commendation. Jessner has been similarly disappointed.

Prior to ultraviolet treatment the parts are washed thoroughly with soap and water, shaved, and then dried. The hairs and crusts must be removed as they obstruct the light. The patient may bend over with the buttocks facing the lamp or assume the knee-chest position, separating the buttocks with hands protected by black cotton, kid, or rubber gloves. In pruritus vulvae the lithotomy position is used. Heuser has overcome the difficulty of conveniently applying the ultraviolet quartz light for an extended period to the region of the perineum by placing the lamp in a chair so that the patient can receive the light while in a seated position. Redundant folds of skin and mucous membrane should be separated by the gloved fingers in order that the light may sterilize all of the recesses. As a rule, second degree erythema doses are recommended.

Radium.—Localized pruritus of the anus and vulva may be successfully treated by flat glazed applicators of radium held in contact with the affected areas. The plaques are preferably screened with 0.1 mm. aluminum or 0.3 mm. rubber. With half-strength applicators exposures of ten to twenty minutes are made at intervals of two weeks. This form of therapy is also advantageously employed upon pruritus of the scrotum as the penetration of all except a negligible fraction of the radiant energy is too slight to injure the testicles.

Other Methods.—Pruritus ani has been favorably influenced by electric ionization and ionic medication, but the results have been too irregular to cause much importance to be attached to the method.

The patient lies on the side with the knees flexed. An indifferent electrode (negative) is applied to the abdomen, and a circular active electrode (positive), which is covered with cotton saturated with salt solution, is pressed against the area under treatment. A galvanic current of 5 to 10 ma. is gradually turned on until the patient feels a warm sensation, and is then continued for fifteen to twenty minutes. Treatments may be repeated daily until the pruritus is under control, after which they may be given three times a week. When the active electrode is positive, one may saturate it with a solution of zinc sulphate, 1 per cent; solution of zinc permanganate, 1 per cent; or solution of mercury oxycyanide. Iodine or Lugol's solution should be applied only when the usual polarity of the active electrode is reversed so that it becomes negative.

PRURIGO

Prurigo is a chronic, toxic, itching, papular affection, which has a predilection for the lower abdomen, buttocks, and the extensor surfaces of the limbs. The papules are minute, rounded, extremely pruritic, flesh-colored, or reddish elevations, frequently excoriated, and the skin between them is often xerotic or eczematized and shows dermographism. The disease usually begins as a papular urticaria in infancy, and, persistently recurring, gradually assumes the characteristics of prurigo, and lasts indefinitely. Incessant scratching causes excoriations, lichenification, pustulation, scars, and enlargement of the superficial lymph glands, the latter being most prominent in the groins and axillae.

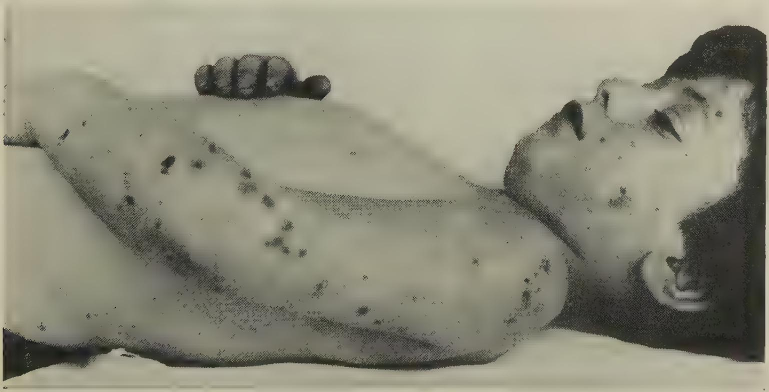

Fig. 227.—Prurigo, showing excoriated papular eruption with characteristic distribution.

Fully developed cases of prurigo both in children and adults have distinctive characteristics. The lesions are distributed chiefly over the extremities, especially the arms and legs, and invariably on the extensor aspects. Some lesions, in addition, are likely to occur on the trunk, scalp, forehead, face, and neck. The groins and axillae, except for adenopathy, are free from skin lesions. The protracted sufferings occasioned by the disease, and perhaps the underlying toxicity as well, lead to constitutional changes. Nervous instability, poor posture, secondary anemia, poor appetite, constipation, spasticity, mental and moral impairment, and malnutrition are associated with it.

Affected children are usually pale, pot-bellied, round-shouldered, and disposed to bed-wetting, masturbation, and bad behavior; while adults may be so harassed by the disease that their business and social activities are seriously limited.

There are three forms of the disease, namely, prurigo mitis, which is common and comparatively mild; prurigo ferox, which is infrequent and severe; and prurigo nodularis of Hebra, which is generally fatal and is exceedingly rare in this country. The first two forms are differentiated only by their intensity, whereas prurigo nodularis is manifested by long-standing nodular, itching tumors on the legs and arms and in many respects resembles the hypertrophic type of lichen planus.

Treatment of Prurigo Mitis and Prurigo Ferox.—Permanent relief is assured solely by treatment of the toxic cause of the condition, diet and tonic measures being the important considerations. Vegetables and proteins should be freely taken, and carbohydrates and raw fruits restricted. The stools should be examined for ova and parasites. For tonic purposes thyroid extract, iron, and iodine are helpful. It is well to supplement these by generalized ultraviolet light in mild erythema exposures once or twice weekly for several months, or in the summer months by outdoor sunlight baths. Local antipruritics containing phenol, 1 to 2 per cent; liquor carbonis detergens, 2 to 3 per cent; sulphur, 2 to 4 per cent; and betanaphthol, 2 to 5 per cent, give comfort and have curative value. These are, as a rule, most effective if applied in ointments. The combination of tar, sulphur, and green soap, known as Wilkinson's salve (see page 98), has special value in this condition, being applied in either half or full strength. The following formula is also beneficial:

℞.	Phenolis	gr. x
	Naftalan	ʒij
	Tannic acid	ʒss
	Ung. zinc oxide	q.s. ad. ℥ij

Dilute Vleminckx's solution (N. F.) or the following lotion, or wet dressings of Burow's solution may be helpful.

℞.	Mentholis	gr. x
	Tinct. benzoin	℥ss
	Alcohol	℥ij
	Phenolis	ʒss
	Tannic acid	ʒj
	Glycerite of tannin	q.s. ad. ℥iv

Unfiltered roentgen therapy affords prompt relief, the dosage for adults being fractional $\frac{1}{4}$ E. D., and for children subfractional $\frac{1}{8}$ to $\frac{1}{6}$ E. D. weekly.

Treatment of Prurigo Nodularis.—Complete removal of the lesions by the high frequency cutting current under novocaine anesthesia should be followed by roentgen therapy. This is administered in suberythema filtered exposures to the entire surface involved. *x*-Ray treatments are repeated at monthly intervals until itching has entirely ceased. Lomholt used radon with good results.

CUTANEOUS NEUROSES

Cutaneous *hyperesthesia* is usually symptomatic of some local or internal disease, in the latter case being due to irritation of reflex nerve pathways, or to direct involvement of the nerves themselves. It is a symptom rather than a disease entity, but in hysteria may form the chief complaint. *Hyperalgesia, anesthesia,* complete or partial, and also *paresthesia* are generally cutaneous manifestations of affections of the cerebrospinal system or peripheral nerves.

In addition to these symptoms there is a variety of expressions of an abnormal psyche on the skin called the cutaneous neuroses. Whereas most of these are of a simple neurotic form, others are consciously associated with ulterior and criminal intent. Treatment belongs in the domain of neurology.

Dermatalgia (Rheumatism and Neuralgia of the Skin).—In this condition there are painful sensations in the skin, without evident cause. Dermatalgia may be associated with cutaneous hyperesthesia or with painful sensations in the structures underlying the skin. Probably the affection is usually preceded by some unrecognizable disease of the nerve centers or peripheral pathways.

Meralgia Paraesthetica.—This affection is a variety of paresthesia in which there are persistent tingling, numbness, and other abnormal sensations on the antero-external surface of the lower part of the thigh. Cases have been reported following flatfoot and proliferative arthritis of the lumbar vertebrae.

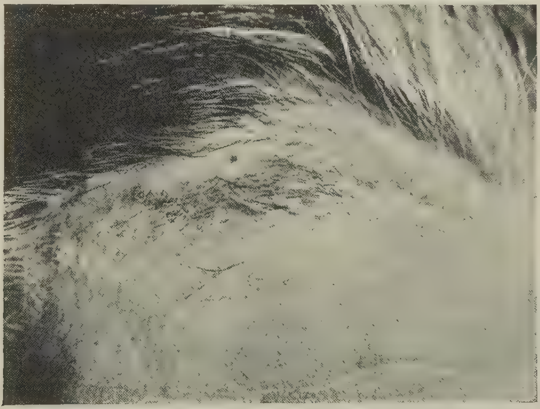

Fig. 228.—Trichotillomania, showing where hair has been pulled out of the front of the scalp above the forehead.

Erythromelalgia (Red Neuralgia).—This is a rare condition which chiefly affects the feet and is characterized by localized pain, redness, and heat. Most of the cases have occurred in adult males and begin with swelling and redness of the fingers or toes, accompanied by severe burning pain which is made worse by motion and pressure. The affection is slowly progressive and may eventually produce gangrene. It is worse in the summer and when the affected parts are dependent; but unlike Raynaud's disease there are no complete remissions. MacLeod calls attention to sclerotic and obliterative changes in the smaller blood vessels similar to those observed in trench foot. Other observers have found evidences of peripheral neuritis, myelitis, and multiple sclerosis. The treatment is rest, elevation of the part and, in severe cases, amputation.

Trichotillomania.—This is a neurosis characterized by an abnormal desire to pull out the hair. There is usually an associated mild pruritus of the scalp or of the part affected. The sites involved are generally the frontal region of the scalp, the eyebrows, and the beard. **Trichokryptomania** is a similar affection, in which the hairs are broken off instead of pulled out.

Dermatothlasia is a cutaneous neurosis in the same category, characterized by an uncontrollable desire to rub or scratch one or more areas on the skin.

Acarophobia is a psychic disorder in which the patient erroneously believes and maintains that his skin is contaminated by some parasite. Patients affected with this disorder pick small pieces of epithelial débris from the skin and bring them to be examined, always with the insistence that the offending parasite is contained in the material. Regardless of advice to the contrary and of repeated examinations with negative results, the abnormal belief persists. Patients are usually very secretive about the matter and will not consult their local physicians concerning it but instead will travel great distances to seek the advice of strangers.

Syphilophobia is an abnormal fear or belief on the part of the patient that he is afflicted with syphilis. This neurosis is not uncommon and is, as a rule, an expression of anxiety regarding some sexual act. The belief is generally amenable to information and argumentative methods of treatment.

Bromidrosiphobia is a neurosis in which there is the conviction that the sweat has a repugnant odor. This, as well as some of the other neurotic symptoms which have been described, may be an early manifestation of dementia praecox.

NEUROTIC EXCORIATIONS

Many persons have unconscious habits of picking themselves, and at times the tendency is persistent and pronounced, so that excoriations of the skin are produced. The lesions are caused by picking, digging, or scraping, and they usually occur on parts readily accessible to the hands. As a

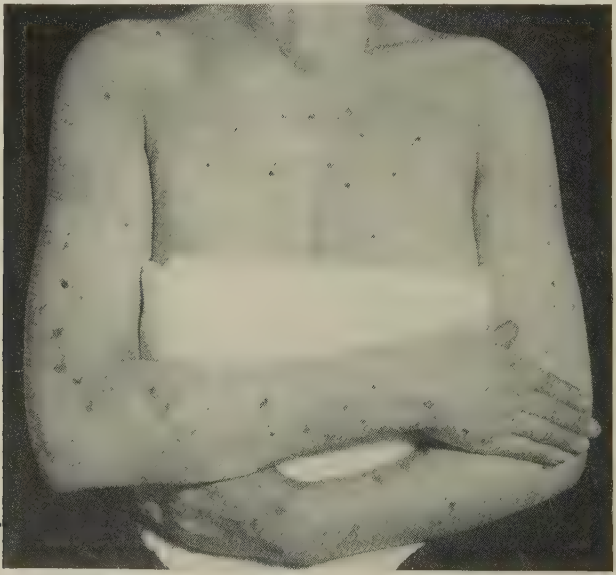

Fig. 229.—Neurotic excoriations. Patient claims to have been bitten by a flea five years ago and ever since has been assiduously picking dead fleas out of the skin. (Courtesy of Dr. Benjamin F. Ochs.)

rule the habit is an unconscious one or is based upon the belief that it corrects some abnormality of the skin. The excavations are superficial or deep, and are often linear. The bases of the ulcers are clean or covered with a scab. One of my patients produced an extensive ulcer at the end of her nose by the daily use of pincers and a magnifying glass for seven years in an endeavor to rid herself of a small hair that she imagined grew there. Later I saw the same patient and although the nose had completely healed with disfiguring scars, she was working on a lesion on the left wrist. In acne urticata the excoriations are accompanied by urticaria, which may be primary or secondary to the mechanical irritation. Excoriated acne of young girls has been described elsewhere.

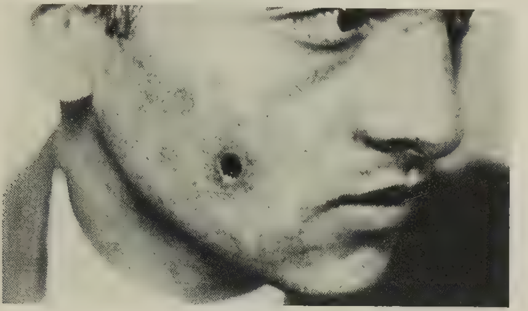

Fig. 230.—Ulcer caused by picking, in a mild case of acne in a neurotic.

DERMATITIS ARTEFACTA

Synonyms.—Feigned eruptions, malingering, dermatitis factitia, hysterical gangrene, neurotic gangrene.

These terms are applied to self-inflicted skin lesions made consciously and often with the intent to elicit sympathy, escape duty, or collect insurance. The subjects are neurotics and most commonly hysterical young women, although men are by no means free from the condition. The skin lesions may be provoked by mechanical means or by the application of chemical irritants and caustics. The lesions may simulate other dermatoses, but usually have a distinctive, clean-cut, bizarre appearance. Frequently the shape and arrangement are such as are not encountered in any other affection. The lesions are generally distributed on parts easily reached by the hands and have a tendency to be linear and arranged regularly and symmetrically. They are rarely seen on the right hand or right wrist unless the patient is left-handed. The eyelids, scalp, interscapular region, and soles are usually unaffected. When chemicals are used one may often see red streaks or guttate marks beneath the principal patch where drops of the chemical have accidentally run or fallen upon the skin. According to the manner of production, the lesions may be erythematous, vesicular, or bullous, ulcerative or gangrenous. The more common agents used are the fingernails, pointed instruments, hot metal, or chemicals such as carbolic, muriatic, nitric or acetic acids, caustic potash or soda, turpentine, and table salt. At times the disorder is manifested only by the indefinitely delayed healing of an operative wound, which is purposely kept open by the patient. The lesions are likely to appear in crops. If there is doubt concerning the diagnosis, the reaction about a recent lesion should be tested with litmus paper to detect the presence of alkali or acid and the parts should be covered by an occlusive dressing of zinc oxide, gelatin, or plaster-of-Paris, which will protect them from ready access by the patient. It is usually best not to reveal any suspicion to the patient and to establish the diagnosis definitely without her knowledge. A resourceful, cooperative nurse may be useful in this connection.

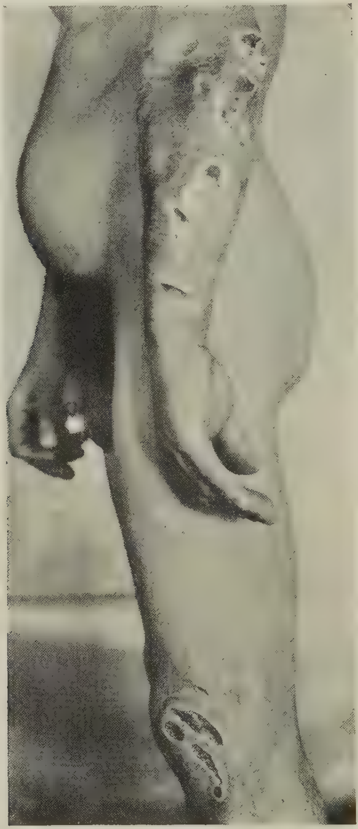

Fig. 231.—Dermatitis artefacta. Self-inflicted lesions produced by the application of phenol. Notice that they are bizarre, clean-cut, and have a tendency to be linear where drops have run down the skin. (Courtesy of Dr. J. Gardner Hopkins.)

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CHAPTER XVI

ECZEMA AND ALLIED CONDITIONS

ECZEMA

Synonyms.—Tetter, salt rheum.

Eczema is a common inflammatory disease of the skin expressing itself in a wide variety of pruritic lesions, which begin as erythema, papules, or vesicles, and in the course of time become exudative, crusted, scaly, or thickened patches. Numerous qualifying terms are used to denote the stage of the process—erythematous, papular, vesicular—or the outstanding clinical characteristic of the lesions (such as weeping, squamous, impetiginous, pustular, fissured, papillomatous, tumefied, lichenified). These are mostly manifestations of secondary conditions: (1) Pustulation, edematous swellings and warty proliferations due to bacterial infection, and (2) lichenification due to rubbing.

The term "eczema" was formerly applied to a large group of such diseases of unknown origin, but as knowledge progressed its use has become more limited, because within the group many disease entities have been identified and otherwise classified—as pityriasis, dermatitis seborrhoeica, dermatitis venenata, dermatophytosis, infectious eczematoid dermatitis. These are considered elsewhere.

Eczema is variously regarded as a form of cutaneous reaction to local irritants in a hypersensitive individual, or as a manifestation of certain endogenous toxins in predisposed areas. Two factors entering into the production of the disease are the eczematizing agent and a receptive skin. The precipitating agents[1] may be focal infections, intestinal, hepatic, pancreatic, or cardiorenal disturbances, pollens or epidermal products, *et cetera*, but in each instance they are likely to be proteins or amino acids. Eczema due to allergy is called allergic eczema. In recent years the rôle of common articles of trade in the production of eczema has assumed increasing importance. Investigations have shown hypersensitiveness and frequently specific antibody formation to numerous substances, as dyes, insecticides, oils, perfumes, soaps, varnishes, and varnish removers. These chemicals have long been known to produce dermatitis venenata in susceptible persons, but apparently other skins react to them by giving rise to eczema. The latter and asthma not infrequently occur in the same patient. The two affections may exist simultaneously or at different times. Asthma-eczema and asthma are analogous in their etiology and clinical course in every respect.

Erythematous Eczema.—Erythematous eczema may occur in any region but is usually encountered upon the face and hands, where it begins with red macules and swelling. The process extends peripherally and by coalescence with other macules until the entire area becomes profusely swollen, erythematous and hot. At the corners of the mouth and in the creases of the neck, fissures may develop from which serum exudes. Often the redness on the neck and upper chest extends to the back of the neck, although the scalp is usually free. This stage of eczema may progress into other phases of the disease in which the skin is crusted, exudative or thickened, or it may completely subside, with a likelihood to recurrence.

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[1] Walter, Franz: Eitererreger und Hautallergie im chronischen Ekzem, Dermat. Wchnschr., 81: 987–998, July 4, 1925. Burnett, F. L.: Etiology, Intestinal Indigestion in Eczema and Psoriasis, Am. J. M. Sc., 166: 415–440, Sept., 1923. Burgess, J. F.: Endogenous Irritants as Factors in Eczema and in Other Dermatoses, Arch. Dermat. and Syph., 16: 131–140, Aug., 1927. Barney, R. E.: Chemical Analysis of Sweat, J. A. M. A., 85: 1373–1376, Oct. 31, 1925. Di Vittorio, A.: Asthma in Its Relation to Eczema, Gior. ital. di dermat. e sifil., 66: 1358, Oct., 1925. Ayers, Samuel, Jr.: Glucose Tolerance Reactions in Eczema, Arch. Dermat. and Syph., 11: 623, May, 1925. Wise, E., and Ramiez, M. A.: Protein Sensitization in Pruritus with Lichenification, Ibid., 11: 751, June, 1925. Usher, B., and Rabinowitch, I. M.: Excretion of Sugar in Sweat, Ibid., 16: 706–713, Dec., 1927.

Papular Eczema.—This type of eczema may be primary or develop upon preexisting erythematous macules and it may become chronic, with various modifications. The lesions are frequently follicular and grouped, consisting of pinhead-sized and larger, acuminate or rounded papules. They are most common upon the extensor surfaces of the extremities, particularly the thighs, and upon the buttocks. Due to rubbing they usually are changed into lichenoid lesions, but at times they progress into scaly patches.

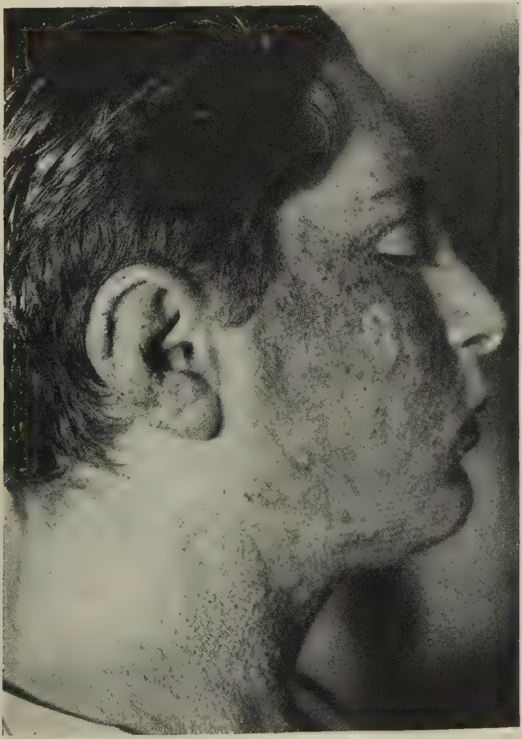

Fig. 232.—Erythematous eczema.

Vesicular Eczema.—In this type of eczema there is pronounced edema which leads to the development of vesicles. These lesions are generally arranged in groups and each vesicle may be surrounded by a hyperemic zone or the group may be surrounded by a red halo, and elevated due to underlying swelling. Vesicular eczema is most likely to occur on the flexor surfaces of the joints or in the interdigits where the skin is tender. In some cases the lesions spread widely so that extensive areas become involved. Although the eruption may completely disappear, as a rule there are recurrences and a gradual transition into chronic types of the disease.

Pustular, also called impetiginous, eczema is a modification of vesicular eczema due to secondary infection. The contents of the vesicles become seropurulent and thick crusts and fissures form.

In the chronic types of the disease an unlimited variety of modifications is observed, to which many descriptive terms have been applied. Squamous eczema is a dry scaly type which leads to a thickening of the skin. It occurs most often upon the legs, but is common on other parts, especially in the sacral and trochanteric regions. Eczema rubrum is another chronic type in which large infiltrated red patches are formed, their surfaces being smooth, shiny, and moist due to exudation.

Diagnosis.—Erythematous eczema must be differentiated from erysipelas, rosacea, and dermatitis venenata. Although the onset is sudden in erythmatous eczema, there are not the constitutional symptoms and leukocytosis which are present in erysipelas. The involvement in both diseases is chiefly of the face, although erythematous eczema may occur on other parts or be widespread. Erythematous eczema lacks the boardy infiltration and the indurated advancing margin so characteristic of erysipelas. In the latter disease there may be bullae. Rosacea is easily distinguished by its gradual development and long course, together with the presence of papules, seborrhea, dilated venules, and the absence of scaling. Dermatitis from chemical irritants may produce an extensive erythematous scaling eruption on the face which closely resembles eczema. The differentiation is made by associated involvement of the hands so common in dermatitis of external chemical origin, by the puffiness of the eyelids, and by the history of exposure to such irritants as insect powders, primrose, dyestuffs, *et cetera*.

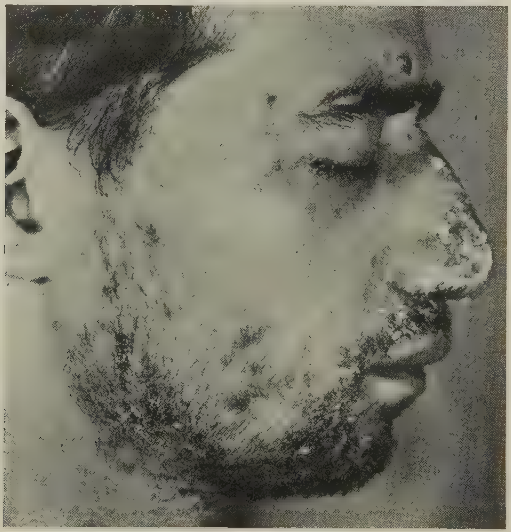

Fig. 233.—Impetiginous eczema. (Courtesy of Dr. Maurice Husik.)

Papular eczema must be differentiated from prurigo, erythema multiforme, the small papular syphilide, lichen planus, and pityriasis rubra pilaris. In prurigo the onset is slow and the eruption has usually been recurrent over a long period. The lesions are situated chiefly on the extensor surfaces of the arms and legs and consist of pruritic papules and scars. The disease usually occurs in childhood. Papular eczema may be seen at any age as an acute outbreak of papules or papulovesicles which are sometimes grouped and affect the extremities especially. In erythema multiforme the sites of predilection are the extensor surfaces of the hands and feet, the wrists and legs, and the lesions of purplish or bright-red papules are frequently ringed. There is a notable lack of itching, whereas that in eczema is usually severe. The onset of erythema multiforme is occasionally accompanied by fever and general adenopathy, the disease being most prevalent in young adults in the spring or fall. The small papular syphilide is a nonpruritic, widespread eruption in which the lesions do not fuse or weep. In lichen planus, the course is chronic and the individual papules are distinctive, as well as the localization on the flexor aspects of the wrists and arms, on the abdomen, legs, penis, and buccal mucosa. In pityriasis rubra pilaris there is a history of long duration and gradual development of small conical, follicular papules with central dark horny plugs which form patches on the scalp, face, hands, trunk, and other parts.

Vesicular eczema must be differentiated from dermatitis venenata, dermatophytosis, drug eruption, scabies, and dermatitis herpetiformis. In infants, vesicular eczema affects the face, and in adults, chiefly the extremities, especially the flexor surfaces of the articulations, where there are groups of vesicles on an erythematous and swollen base. These ultimately rupture and become covered with yellowish crusts. In dermatitis venenata, the lesions are worst on exposed parts and in men also have a tendency to affect the genitals. The vesicles are frequently large; or they may even be bullae and they are likely to be arranged in a linear manner. The eyelids are generally puffy. Dermatophytosis of the vesicular type is differentiated from vesicular eczema by a tendency to affect the interdigits, especially in the fourth interspace of the toes, and to be arranged in rings. Frequently a diagnosis is impossible without prolonged observation and numerous attempts to demonstrate fungi. Eruptions due to bromides and iodides, as well as other drugs, may closely simulate vesicular eczema. As a rule, the patches are more hyperemic and edematous when due to drugs and may even be hemorrhagic. The vesicular variety of scabies gives no difficulty in differentiation from vesicular eczema if the body is examined carefully, for the latter is never so widespread as the former, and in scabies there are associated papular lesions with a predilection for typical locations, the face being exempt. Dermatitis herpetiformis is a chronic recurrent disease in which vesicles occur in crops and are grouped in patches which have a predilection for the shoulders, axillae, and buttocks. The vesicles are almost always associated with papules. The vesicles are usually larger than those encountered in vesicular eczema, and the long duration of dermatitis herpetiformis, as well as its tendency to grouping and to involvement of certain areas, gives a definite basis for differentiation.

Pustular eczema must be differentiated from both sycosis vulgaris and tinea barbae, from impetigo, favus, and pediculosis. Pustular eczema runs an acute course, whereas both forms of sycosis, as well as favus, are chronic, and these diseases are also distinguished by characteristic symptoms. In tinea barbae the involvement is generally of the mandibular and submaxillary regions, with nodular and boggy tumefaction and the hairs are broken or loose. In sycosis vulgaris any part of the bearded region may be affected, but the upper lip is the most frequent site, the patches being composed of follicular papules, pustules, and crusts. Both forms of sycosis occur in male adults, and the causative organisms may easily be isolated in each of them. Pustular eczema is encountered mostly in childhood and the lesions are primarily vesicles or, less often, pustules, which may or may not be follicular, and affect principally the scalp and face. Favus and tinea tonsurans are distinguished from pustular eczema by the occurrence of scutula and sulphur yellow crusts, as well as scars and alopecia in the former and by broken-off hairs in crusted, erythematous, pustular patches in the latter, the diagnosis in doubtful cases being confirmed by microscopical demonstration of fungi. In impetigo the lesions are vesicles and bullae which later become pustular and there are the characteristic light-yellow crusts. The lesions occur most often on exposed parts, such as the face, neck, and hands. In pediculosis the ova or lice may be seen and there are excoriations or enlarged glands or secondary impetigo.

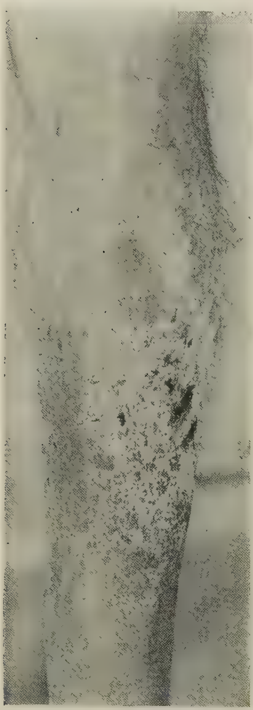

Fig. 234.—Squamous eczema resembling psoriasis.

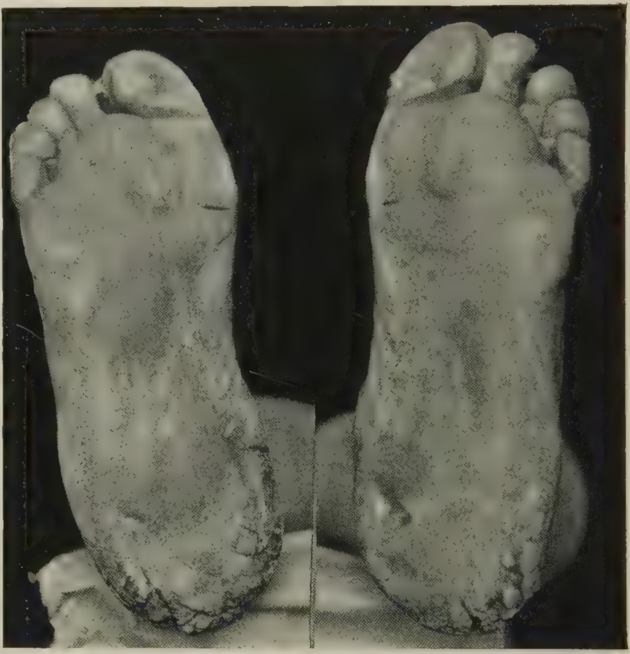

Fig. 235. — Squamous eczema with warty proliferations. (Stelwagon.)

Squamous eczema must be differentiated from seborrheic dermatitis, psoriasis, the squamous syphilide, ringworm, pityriasis rosea, and dermatitis exfoliativa. Squamous eczema affects chiefly the hands, legs, and face with scaling patches which are sometimes thickened and fissured. The scales are large, but thin and sparse, being grayish-white and readily removable. In seborrheic dermatitis, the favorite sites are the scalp, ears, about the eyes and mouth, in the creases of the neck, on the sternal and interscapular regions, and in the axillae and groins. The lesions are well-defined, yellowish-pink patches covered with greasy, fine scales. In psoriasis, the involvement is of the extensor surfaces, particularly over the articulations and on the scalp, and the lesions are papules or patches, well-defined and covered with micaceous scales which leave bleeding points when they are removed. The squamous syphilide affects chiefly the palms and soles with infiltrated, marginated, and usually configurate patches which tend to clear in the center while spreading at the periphery. The lesions produce no itching and may be accompanied by other evidences of the disease. The Wassermann test is positive. In ringworm, the favorite sites are the inner thighs and groins, and the armpits, where there are brownish, crusted, flat patches with a clear-cut border which is slightly vesicular. The fungus may be demonstrated. In pityriasis rosea, the duration is but a few weeks, whereas squamous eczema, as a rule, runs a chronic course. Pityriasis rosea occurs as a herald patch which is soon followed by an eruption of oval, fawn-colored spots on the trunk, upper arms, and thighs. The lesions are rarely over 2 cm. in length and on the back have a tendency to follow the lines of the ribs. The epidermis in the center of the patches is crinkled and there is slight scaling. In dermatitis exfoliativa a generalized and diffuse erythema and scaling, without infiltration, are present. There may be constitutional symptoms and generally there is much discomfort caused by itching and burning.

Treatment.—No universally applicable rules can be given for the therapy of eczema because of the great variety in the lesions, the different locations involved, and individual factors, such as age, health, occupation, and sensitivity of the skin to remedies.

The *constitutional treatment* demands relief of nervousness by rest, by the abatement of pruritus, and the avoidance of stimulants. Disturbances of the general health should be diligently investigated and treated. As experience has shown that certain foods aggravate the disease, these should be excluded from the diet. Overeating should be prevented and alimentary excretion should be increased. The following diet list may be modified to suit the individual case:

A simple diet consisting chiefly of vegetables. The avoidance of anything likely to produce irritation of the skin is essential, especially such foods as: shellfish, fish, preserved meats, cheese, excessive portion of protein or carbohydrate (starches), sweets, unripe fruit, uncooked berries, strong coffee or tea, alcohol, spices, pickles, and condiments.

Allowed breadstuffs, cereals, dairy products, ice cream, milk, and egg desserts and other simple desserts; unless otherwise instructed.

Eat some kind of fruit at every meal.

Eat two green vegetables or one green vegetable and a salad at both luncheon and dinner.

Vegetables permitted:

- Artichokes
- Asparagus
- Beans
- Beets
- Broccoli
- Brussels sprouts
- Cabbage
- Carrots (young)
- Cauliflower
- Celery
- Cresses
- Cucumber (baked)
- Dandelion greens
- Eggplant (stewed or grilled)
- Endive
- Greens
- Kohlrabi
- Leeks
- Lettuce
- Mushrooms
- Onions (boiled)
- Oyster-plant
- Parsnips
- Peas
- Pumpkins
- Rhubarb
- Sorrell
- Spinach
- Squash
- Swiss chard
- Turnips
- Vegetable marrow

The clothes should not be heavy enough to cause overheating or perspiration, but should still be sufficiently warm to avoid chilling, to which there is a tendency. Cleansing of affected areas of skin may be accomplished as much as possible by olive oil, linseed oil, mineral oil, or cleansing cream on cotton, without undue rubbing. Baths should be infrequent and tepid, and followed by drying with a soft hand-towel without rubbing. To a tubful of water may be added gelatin (2 teaspoonfuls) or starch (1 pound), sodium bicarbonate (1 cup), oatmeal (½ pound), bran (½ pound), carbolic acid (½ ounce), or Burow's solution (1 pint). Soap must be avoided.

Hypodermic injections of more or less specific proteins are at times beneficial in the treatment of allergic eczema. Having achieved merely casual success with the usual intradermal food, bacterial and epidermal protein tests, I have worked with fresh cultures from a stool obtained from high up in the intestine. Enough castor oil is given to cause two or three bowel movements. The second or third is diluted and cultured in broth, and upon glucose and blood agar. The organisms grown are isolated into separate cultures, killed by incubation, and made into suspensions of fifty million per cubic centimeter. Intradermal tests are made with each of these upon the flexor surfaces of the forearms with a control of normal saline solution. The injections are 0.05 cc. given with a tuberculin syringe, this quantity being enough to cause a small wheal. When positive, local reactions such as large swollen, tender, erythematous nodules or plaques, 1, 2, or 3 inches in diameter occur within twenty-four hours and subside after three to seven days; reactions smaller than an inch in diameter should be regarded as negative. A mixed vaccine is made from the organisms giving positive reactions, the number being two billion per cubic centimeter of mixture. The proportion of each organism in the vaccine is in accord with the size of the reaction to it. The first injection consists of 2 minims, and the dose is increased 2 minims every fourth day to a maximum of 60 minims. If severe reactions occur, the interval before the next injection should be lengthened or the amount of the next dose decreased. Such treatment should be persistently used for at least three months. The best results have been obtained in patients who have had fairly severe local reactions, associated with slight malaise to large doses given over a period of four to six months. The organisms often showing positive reactions are Streptococcus haemolyticus and the colon bacillus. Occasionally the Staphylococcus haemolyticus has given positive tests.

As some basis for the above procedure, it may be stated that, although diet is advisable in cases of eczema, it is rarely completely curative because much depends upon the intestinal flora. In spite of the fact that eczema is sometimes due to a food sensitization in an allergic person, the intradermal food tests followed by a total elimination of offending foodstuffs from the diet seldom suffice, the best results being reported by Vaughan, who obtained definite relief during the period of avoidance of the specific food protein in 55 per cent of his cases. During the process of digestion, the foods are chemically transformed into simple products by the enzymes of the digestive fluids and then further changed by the metabolic activities of the intestinal bacteria. Burgess has obtained positive reactions to metabolic end-products and toxins formed in the bowel in 16.7 per cent of eczema cases tested. He found that the vast majority of positive reactions were due to toxins produced by bacterial action on food products, while a few were caused by amino-acids normally occurring in the intestine in the process of digestion.

In accordance with the suggestions of Burgess, I have obtained helpful information by intradermal tests with 1 : 1000 fresh aqueous dilutions of allylamine, α-aminopropionic acid (alanine), cadaverine hydrochloride, choline hydrochloride, histamine, β-iminazolyl ethylamine dihydrochloride, indol, l-leucine, pentamethylenediamine (cadaverine), phenylethylamine hydrochloride, putrescine dihydrochloride, scatol, trimethylamine (base) and tyramine. "The mechanism of the action of these intestinal irritants would seem to be that of a sensitizing agent in the presence of an allergic disposition. The substances tested here are but a few of the possible toxic bodies found in the intestines. It is likely that these bodies may be frequently found in small amounts in the intestinal contents, but when putrefaction exists to any degree, considerable amounts of these toxins are probably formed. It would then seem necessary that a lessening of the defense forces of the body (liver) should be present to allow them to circulate unoxidized in the blood stream. The ability of these substances to cause reactions in the skin would then depend upon the basic hypersensitiveness of the eczematous person to that particular irritant. General nervousness is a frequent accompaniment

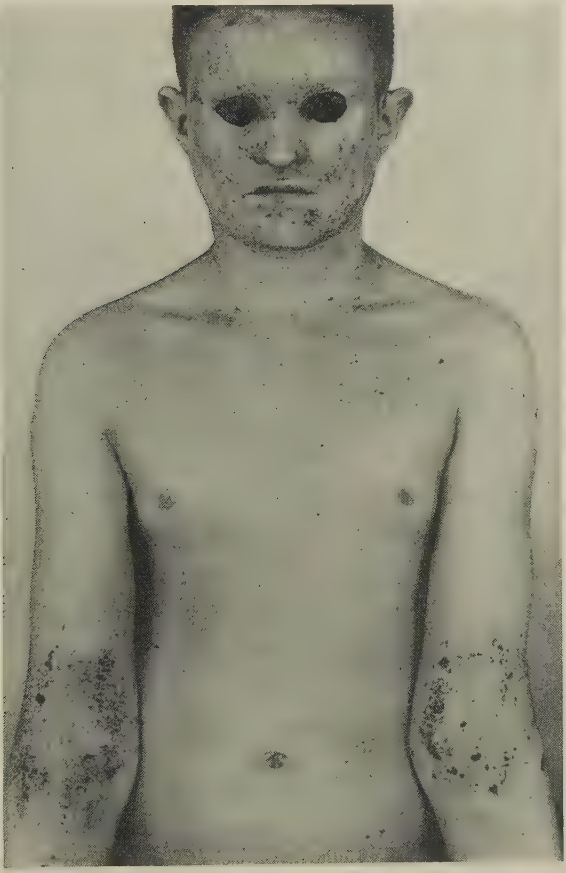

Fig. 236.—Allergic eczema. (Courtesy of Dr. Beatrice M. Kesten.)

in cases of eczema of endogenous origin. It would seem, also, to result from the toxic action of these putrefactive products."[1]

I have ineffectively tried filtrates of the stool for immunization purposes on the grounds that many organisms may be present in the intestines and not submit to culture. Aolan, sterile milk, and other nonspecific proteins have been used with doubtful benefit. In some cases of hay-fever or asthma accompanied by eczema, intradermal tests and desensitization are specific. Although there is much prejudice against skin sensitization tests,[2] I believe they should be done in every case of chronic eczema in which the patient does not respond to ordinary methods of treatment, because they are so easy to perform and occasionally assist in determining the causative agent. A subject should be tested not only for food, bacterial, pollen, and epidermal proteins, but also for all trade products and household articles, and plants with which he comes in contact. All positive tests should be repeated three or four times at monthly intervals for confirmation.

Positive reactions to egg, wheat, milk, fish, glue, cotton, silk, kapok, feathers and hairs have, in my experience, been of most significance. Certain substances, such as tuna fish and histamine, cause wheals on almost everyone and therefore are more confusing than helpful. Reactions to lettuce, spinach, beef, rice, etc., are usually accidental and are not confirmed when the tests are repeated. Those who react to asparagus usually also react to the pollens of spring grasses. Reactions in which outward prolongations, called pseudopods, occur are more important than those which lack this feature. Tests should be made not only upon areas of normal skin, but upon places affected by the disease, as the sensitization may be localized to the latter areas. The subject of allergy is not well understood, but it seems that negative skin reactions have little value.

The history of each case also should be thoroughly taken because it sometimes suggests the causative agents in spite of negative skin reactions. It may, however, be necessary to rely upon analysis of the cause by experimenting with various diets. Rowe has formulated a series of trial diets containing foods which infrequently cause allergic disturbances. "The general principle in the formulation of these diets, moreover, has been to include one or two starches, and meats, from two to four vegetables and fruits, together with sugar, oil, and salt. Oil may be either olive, cottonseed, or maize oil according to the likelihood of sensitization to any of them, and comparatively large amounts of oil should be taken on salads and of sugar on fruits and in fruit drinks in order to increase the calories. The physician or the dietitian can help the patient plan quite satisfactory menus from the foods in these various diets, insisting on the strict exclusion of even the slightest ingredient in the diet which is not in the prescribed list. Four elimination diets are detailed. The menu for Diet 1 illustrates the possibility of insuring with such an 'elimination diet' a fair intake of protein, vitamins, mineral salts, and calories.

"The diet best suited for the patient can be selected by the physician and other similar diets can be formulated if the physician desires. I have found that Diet 1 has been most useful, though occasionally sensitizations are present to one or more foods in this diet, necessitating the substitution of similar foods to which patients are not sensitive, as shown in Diets 2 and 3. Diet 4 is planned for a possible sensitization to all meats.

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[1] Burgess, J. F.: Endogenous Irritants as Factors in Eczema and in Other Dermatoses, Arch. Dermat. and Syph., 16: 131–140, Aug., 1927.

[2] The technic for performing these tests is described on page 348.

TABLE 23[1]

"Elimination Diets" for the Treatment of Food Allergy

	Diet 1.	Diet 2.	Diet 3.	Diet 4.	Diet 5.
Cereal	Rice (natural)	Corn	Rice Tapioca	Rice Rye	Milk alone for the test period—2 to 3 quarts a day
Bread	None	Corn pone[2]	None	Rye rice[3] Rye crisp	
Meat or fish	Lamb	Bacon Chicken	Beef	Cod, halibut and white fish	
Vegetables	Lettuce Spinach Carrots	Squash Asparagus Peas Artichokes	Tomatoes Celery String beans	Lettuce Carrots Peas Beets	
Fruits and jams and fruit drinks	Lemon Pears Peaches	Pineapple Apricot Prunes	Grapefruit Pears Peaches	Pineapple Apricots Pears	
Miscellaneous	Sugar Olive oil Salt Olives (unstuffed) Maple syrup Gelatin	Sugar Mazola oil Salt	Sugar Wesson oil Salt Gelatin Maple syrup	Sugar Olive oil Salt Olives (unstuffed)	

[1] From Rowe.

[2] Corn pone is made with cornmeal, salt, water, and Crisco.

[3] Rye rice bread: $\frac{1}{3}$ cup rye flour, $\frac{2}{3}$ cup rice flour, 6 level teaspoonfuls baking powder (Royal), 4 level teaspoonfuls sugar, $\frac{1}{4}$ teaspoonful salt, $\frac{2}{3}$ cup water, $\frac{1}{2}$ teaspoonful shortening. This recipe makes eight small muffins. This recipe doubled can be made into a loaf. Perhaps more palatable if toasted. Royal baking powder does not contain egg.

"The milk diet may be used if the patient does not give indications of milk sensitization. In such a case if symptoms are relieved with the exclusive use of milk, other foods may be gradually added, the effect of such additions being watched.

TABLE 24[4]

Menu for Diet 1

Breakfast:	
Rice	Boiled, natural, served with peach or pear juice and sugar fried in olive oil and served with sugar or maple syrup.
Pears or peaches	Large helping, fresh or canned.
Drinks	Lemonade with plenty of sugar.
Lunch and dinner:	
Soup	Lamb broth with rice and carrots.
Salad	Lettuce with pears or peaches with olives and olive oil and lemon. Green or ripe olives, unstuffed.
Meats	Roast lamb with gravy made with rice flour. Broiled lamb chops.
Vegetables	Spinach or carrots. Boiled natural rice.
Dessert	Lemon gelatin or pears or peaches.
Drinks	Lemonade with plenty of sugar.

"1. Absolutely no foods other than those specified in each diet can be used. Thus, in Diet 1 rice must not be fried with butter or lard but only with the fat specified, which is olive oil. Absolutely no bread, milk, cream or other nonspecified foods can be used.

"2. Prescribed fruits can be used in drinks, in salads, for desserts and for jams and sauces.

"3. Gravies for meats and sauces for vegetables can be thickened only with flour allowable, *i. e.*, rice in Diet 1; cornstarch in Diet 2, and so on

"4. Olive oil in Diet 1, corn oil in Diet 2 and cottonseed oil in Diet 3 are indicated according to sensitizations to olive, corn or cottonseed antigens. These may be interchanged if necessary.

"5. Calories must be increased by plenty of sugar, oil, and starch prescribed. Vitamins must be assured by plenty of vegetables and fruits prescribed.

[4] From Rowe.

"6. In Diet 2, baked corn pone made with cornmeal and water, or cornmeal mush fried in maize oil or bacon fat eaten with prune or apricot juice or plain sugar syrup would be in order.

"7. In Diet 3, tapioca, baked with peaches and sugar and flavored with orange or orange peel may be suggested.

"8. In Diet 4, if the patient is sensitive to fish but not to eggs, eggs may be substituted.

"9. These diets are models on which other diets composed of foods indicated by history of food sensitizations and skin tests may be formulated if desired by physicians. Diet 1 has been found especially useful either as it is or with foods substituted for those to which patients were sensitive.

"10. The 'elimination diet' found to relieve the patient's symptoms can be increased by gradual addition of foods to which the patient is found to be nonsensitive as outlined in this article."

Dale and Thornburg state: "The four 'elimination diets' which Rowe uses are composed of from fourteen to sixteen foods selected from those which cause allergy least often. They vary in the cereals, meats, vegetables, and fruits used. Final choice of the first test diet depends somewhat on the patient's history of food idiosyncrasies and on the indications of positive skin reactions. If symptoms are not relieved by use of the first diet for a period of from five to seven days, a second test diet is tried. Usually this is not necessary. If symptoms are relieved, one or two vegetables and fruits are added the second week; then meats, starches, and other vegetables and fruits are added gradually in succeeding weeks, any foods which reproduce symptoms being excluded. The process of building up a normal varied diet may be long, and meanwhile there is danger from a restricted diet. Rowe himself says: 'Such "elimination diets" cannot be allowed for more than a week at a time because of the lack of satisfactory balance, especially in the vitamin and mineral salt content of such diets.' The chief deficiency of his diets is in calcium, the most important source of which in the normal diet is milk.

"Because Rowe's principle of study is sound and because his handling of 'elimination diets' has been eminently successful, his work has been used as a basis for the development of diets which are entirely adequate in protein, minerals, and vitamins for adults, and in all food factors except calcium and phosphorus for children. Even for those two elements the allowance is fair, although not optimum, as will be shown later."

Dale and Thornburg (to whom special acknowledgment is here made) offer two diets (Tables 25 and 26). "The diets are therefore more varied than the Rowe diets, but they are not necessarily more likely to include foods to which patients are sensitive. Diet 1 contains seven foods for which Rowe reports a total of twenty sensitizations in a series of 556 sensitizations among 175 patients. Diet 2 contains seven foods which gave a total of twenty-four sensitizations in the same series. The other foods used in these diets have not been reported as allergens by Rowe. (Several of them have been reported by other investigators.) The first of Rowe's 'elimination diets' contains seven foods which he has found to be allergens thirty-six times in his series; the second nine foods, which have been allergens twenty-eight times; the third eight foods, with fifty sensitizations reported against them, and the fourth, ten foods with forty-two sensitizations.

"Unlike the Rowe diets, the two that are offered here have no articles in common except salt, sugar, and gelatin, to which sensitization has never been reported. If trial with both these diets used successively fails to relieve symptoms, it is probable that the symptoms are not due to allergy or else that the protein is effective by inhalation or contact rather than by ingestion. Of course, if the history of the patient suggests sensitization to any one of the articles in either diet, that article would not be employed in the preliminary tests. Possible substitutions within the diets are suggested in Table 27.

"In general, the Rowe principle of choice of foods has been followed. Wheat, eggs, milk, and other foods which frequently cause allergy are eliminated. Unusual foods are used in preference to usual ones, although the diets are entirely practical. In some localities and at some times of the year a few substitutes may be necessary. Usually those foods which are not always fresh in the markets may be obtained in canned form.

"Since diets lacking milk and cheese are almost always deficient in calcium the calcium content of foods in the diets has been carefully considered. Green leaf vegetables are used in large amounts in both diets; molasses is used in one diet and maple syrup in the other. Other foods, such as filberts, rhubarb, and turnips, have been included because they are fairly rich in calcium. In using the diets it must be remembered that meats, fish, and cereal products are always deficient in calcium. The first two will be used in liberal amounts to meet the protein and phosphorus requirements of an adequate dietary. Their protein should be supplemented, however, with protein from nuts and lentils since the latter yield calcium as well.

"The cereals will be used in amounts just sufficient to yield the necessary energy, to render the diets palatable and to limit the bulkiness of the foods. Fats will be reduced to a minimum since they are sources of energy alone.

"Phosphorus will be provided in adequate amounts by the protein-rich foods, except gelatin, by the fruits and vegetables and by brown rice. Iron will be liberally provided by the leafy vegetables. These will also give an abundance of vitamins A and B. Vitamin C will be provided in most significant amounts by lemon juice in Diet 1 and green bell peppers in Diet 2. The leafy vegetables which are used uncooked will be good sources of this vitamin and the cooked ones will be fair sources if cooking is not unduly prolonged. Detailed statements of the various food factors are given for the diet lists in Tables 25 and 26.

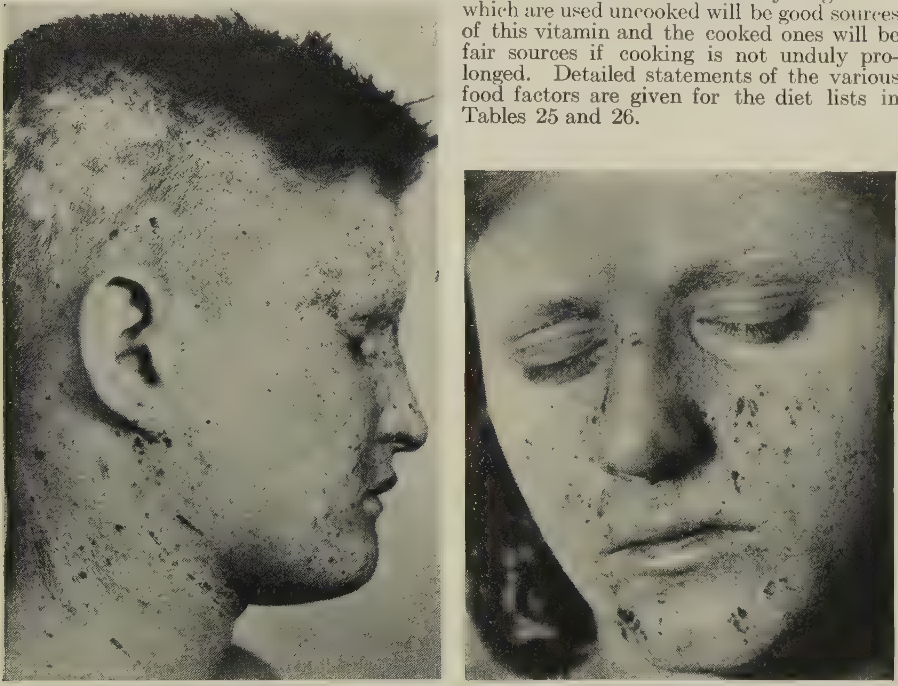

Fig. 237. Fig. 238.

Figs. 237, 238.—Allergic eczema. Note relative freedom of ears and eyelids.

"Five menus (Tables 28 and 29) have been prepared for adults from each diet list in order to show that it is possible to provide varied palatable meals which meet all nutritional standards for the five days during which the diets will normally be used without change or addition. Palatability must be considered, because few patients will force themselves to eat unpalatable food and restriction in amount taken will inevitably mean deficiency in one or more of the essential food factors.

"In practice, Diet 1 is prescribed as it stands, unless the history of the patient suggests elimination of one or more definite foods. In that case equivalent substitutions are made. If symptoms are not relieved after a period of five days, Diet 2 is prescribed with similar attention to suggested idiosyncrasies of the patient.

"If symptoms are relieved, milk is added to the diet with careful observation of its effect. If the adult is sensitive to milk, it is removed from the diet a second time. The patient is then allowed other foods, one being added at a time and preferably vegetables, another meat and then fruits being used. From three to four days are allowed between each addition when symptoms do not reappear; if they do, the suspected food is eliminated at once. Foods least likely to cause trouble are added first until a varied diet is attained. Then experimental addition is made of wheat, eggs, potatoes, chocolate, oranges, tomatoes, and the other foods which frequently cause allergy.

"If the patient is not sensitive to milk, as shown by freedom from symptoms when it

TABLE 25—DIET 1[1]

Material.	Approximate measure.	Weight.	Protein.	Fat.	Carbohydrate.	Calories.	Calcium.	Phosphorus.	Iron.	Vitamins.		
										A.	B.	C.
Corn (4)	1 cup, stewed	250 Gm.	7.0	3.0	47.5	245	0.015	0.258	2.0	+	+	+
Eggplant (2)	$\frac{3}{4}$ cup, stewed 4 slices, $\frac{1}{2}$ inch thick, 3 inches diam.	150 Gm.	1.8	0.5	7.7	42	0.017	0.051	0.8	+	+	..
Endive	$\frac{2}{3}$ small head, raw	100 Gm.	1.5	....	3.0	18	0.104	0.038	?	+	..	+
	1 cup, cooked	200 Gm.	3.0	....	6.0	36	0.208	0.076	....	..	..	..
Parsnips	1 cup, mashed	220 Gm.	3.5	1.1	29.7	143	0.130	0.167	1.3	..	++	..
Spinach	2 cups, raw	100 Gm.	2.1	0.3	3.2	24	0.067	0.068	3.6	+++	+++	+++
	1 cup, cooked	200 Gm.	4.2	0.6	6.4	48	0.134	0.136	7.2	+++	+++	+
Turnip, white (2)	Raw, $1\frac{1}{2}$ small; $\frac{3}{4}$ cup diced	100 Gm.	1.3	0.2	8.1	39	0.064	0.046	0.5	..	++	++
	Cooked 3 small, 1 cup diced, $\frac{3}{4}$ cup mashed	200 Gm.	2.6	0.4	16.2	78	0.128	0.092	1.0	..	..	..
Dates	10 stoned	64 Gm.	1.3	1.8	50.2	222	0.042	0.036	1.9	..	..	..
Lemon juice (3)	2 tablespoonfuls	26 Gm.	....	....	2.5	10	0.006	0.003	....	+	++	+++
Prunes (2)	6 whole	65 Gm.	1.2	....	40.4	166	0.030	0.058	1.7	++	++	—
Rhubarb sauce	1 cup thin	......	0.9	1.1	61.5	255	0.067	0.047	1.5	..	..	+
Cornflakes	$1\frac{1}{2}$ cups	40 Gm.	3.4	0.3	34.8	156	0.007	0.076	0.4	..	—	—
Cornmeal mush	1 cup from $\frac{1}{5}$ cup raw	30 Gm.	2.8	0.6	22.6	107	0.005	0.057	0.3	..	—	—
Corn pone (molasses)[2]	1–3 inches diameter, $\frac{3}{8}$ inch thick	......	2.4	3.8	21.4	130	0.012	0.049	0.5	..	+	—
Cornstarch	1 tablespoonful	8 Gm.	....	....	7.2	29	.....	.....	....	—	—	—
Hominy	1 cup cooked from $\frac{1}{2}$ cup raw	95 Gm.	7.9	0.6	75.1	337	0.010	0.137	0.9	..	..	..
Gelatin	1 tablespoonful	$\frac{1}{2}$ oz.	13.0	0.2	.....	52	.....	.....	....	—	—	—
Hazelnuts	30 meats, $\frac{1}{4}$ cup cut	25 Gm.	3.9	16.3	3.3	176	0.072	0.089	1.0	..	++	..
Lamb (3)	1 large lean loin chop	188 Gm.	30.1	22.7[3]	.....	325[3]	0.017	0.324	4.5	..	+	—
	Roast—3 oz. cooked from	$4\frac{1}{2}$ oz.	24.5	21.1	.....	288	0.014	0.264	3.7	..	+	—
Lentils	$\frac{1}{2}$ cup cooked from $\frac{1}{4}$ cup raw	50 Gm.	12.9	0.5	29.6	175	0.054	0.219	4.3	+	++	..
Mackerel	4 oz. raw	4 oz.	21.2	8.0	.....	157	0.023	0.243	1.2	..	+	..
Corn oil	1 tablespoonful	12 Gm.	....	12.0	.....	108	.....	.....	....	—	—	—
Bacon	3 slices	62 Gm.	6.5	20.1[3]	.....	207[3]	0.004	0.070	0.9	..	+	—
Molasses	1 tablespoonful	22 Gm.	0.5	....	15.2	63	0.046	0.010	1.6	—	+	..
Sugar	1 tablespoonful = 3 teaspoonfuls = $\frac{1}{16}$ cup	13 Gm.	.....	....	13.0	52	.....	.....	....	—	—	—
Coffee (4); parsley; salt												

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[1] Numbers in parentheses refer to incidents as allergens in Rowe's series. The values of the foods used in these diets have been obtained from many sources, the most important of which are: Sherman: Chemistry of Food and Nutrition; Rose: Laboratory Handbook for Dietetics; Joslin: The Treatment of Diabetes Mellitus, and Bulletin 28, U. S. Department of Agriculture.

[2] Molasses corn pone is prepared according to the following recipe: Cornmeal, 2 cups; oil, 3 tablespoonfuls; molasses, 2 tablespoonfuls; salt, $\frac{1}{4}$ teaspoonful; water, approximately $\frac{3}{4}$ cup. Mix cornmeal, salt, oil and molasses; pour on enough boiling water to make a stiff paste. Drop by spoonfuls on oiled sheets and bake in a moderate oven until well browned. This quantity makes twelve cakes, 3 inches in diameter and $\frac{3}{8}$ inch thick.

[3] Corrected for loss in cooking and eating.

TABLE 26—DIET 2

Material.	Approximate measure.	Weight.	Protein.	Fat.	Carbohydrate.	Calories.	Calcium.	Phosphorus.	Iron.	Vitamins.		
										A.	B.	C.
Brussels sprouts	9 medium	200 Gm.	3.0	0.2	6.8	42	0.054	0.240	2.2	..	..	..
Okra	1 cup canned	225 Gm.	3.6	0.5	10.0	58	0.160	0.043	?	..	+++	..
Pepper, green (1)	1 small	50 Gm.	0.8	0.1	2.3	13	0.003	0.013	0.2	++	+	+++
Pumpkin	1 cup cooked (dry)	250 Gm.	2.0	0.5	18.8	88	0.058	0.148	2.0	+	+	+
Rutabaga	1 cup mashed from raw	230 Gm.	3.0	0.5	19.6	94	0.170	0.129	?	..	++	++
	1 cup diced from raw	200 Gm.	2.6	0.4	17.0	82	0.148	0.112	?	..	..	..
Swiss chard	1 cup cooked	200 Gm.	3.0	....	6.0	36	0.300	0.080	5.0?	++	+	..
Watercress	2 cups raw	100 Gm.	0.7	0.5	3.7	22	0.187?	0.005	1.9	+++	..	+++
Apricots (6)	9 halves + 5 tablespoonfuls juice	....	1.3	0.3	36.0	152	0.017	0.030	0.4	..	..	..
Pears, canned	3 halves + 3 tablespoonfuls juice	133 Gm.	0.4	0.4	24.0	100	0.010	0.017	0.2	..	+	..
Pears, fresh	1 small	90 Gm.	0.5	0.4	11.4	50	0.014	0.023	0.3	..	..	..
Pineapple (3)	1 slice + 3 tablespoonfuls juice or ¼ cup shredded	....	0.3	0.5	24.0	100	0.012	0.019	0.3	++	++	++
Raisins (3)	¼ cup	56 Gm.	1.5	1.8	42.6	193	0.036	0.074	1.2	—	+	—
Chicken (2)	1 second joint with bone	70 Gm.	18.5	7.0	.....	137	0.011	0.199	2.8	..	..	..
	1 leg with bone	60 Gm.	16.0	6.0	.....	118	0.009	0.172	2.4	..	..	..
	2 small slices (3 × 3 × ⅛ inch)	30 Gm.	8.0	3.0	.....	59	0.005	0.086	1.2	..	..	..
Codfish	⅝ cup flaked	3 oz.	14.4	0.4	.....	62	0.016	0.165	0.8	..	+	..
Gelatin	1 tablespoonful	½ oz.	13.0	0.2	.....	52	.....	.....	....	..	..	..
Pecans	32 meats; ¼ cup shelled	40 Gm.	3.8	28.2	6.1	294	0.036	0.134	1.0	+	+	..
Rice, brown (7)	1 cup cooked from ⅔ cup raw	75 Gm.	6.0	0.1	59.0	263	0.008?	0.154	1.5	+	++	—
Rice flakes	1 cup	33 Gm.	3.3	0.1	27.1	123	?	?	?	—	—	—
Rice flour	1 tablespoonful	8 Gm.	0.6	....	6.3	28	0.001	0.008	0.1	—	—	—
Tapioca	1 tablespoonful minute	11 Gm.	....	....	9.7	39	0.003	0.001	0.2	—	—	—
Coconut oil	1 tablespoonful	12 Gm.	....	12.0	.....	108	.....	.....	....	..	—	—
Maple syrup	1 tablespoonful	20 Gm.	....	....	14.3	57	0.021	0.003	0.6?	..	..	..
Sugar	1 tablespoonful	13 Gm.	....	....	13.0	52	.....	.....	....	—	—	—
Nutmeg; salt; tea (2)												

TABLE 27—POSSIBLE SUBSTITUTES FOR FOODS IN DIETS 1 AND 2[1]

Material.	Approximate measure.	Weight.	Protein.	Fat.	Carbohydrate.	Calories.	Calcium.	Phosphorus.	Iron.	Vitamins.		
										A.	B.	C.
A. Dandelion....(0)	2 cups raw........................	100 Gm.	2.4	0.9	10.6[2]	61	0.105	0.072	2.7	++	++	+
Mustard.....(3)	2 cups raw........................	100 Gm.	2.4	0.3	4.5	30	0.220	0.066	5.6	..	..	..
B. Kale........(0)	2 cups raw........................	100 Gm.	3.0	0.4	2.1	24	0.064	0.057	3.1	++	+++	..
Celery.......(7)	⅘ cup diced; 10 medium stalks.......	100 Gm.	1.1	0.1	3.3[2]	19	0.078	0.037	0.5	..	++	..
Kohlrabi.....(0)	¾ cup diced......................	100 Gm.	2.0	0.1	5.5	31	0.077	0.071	0.6	..	+++?	..
C. Asparagus....(1)	4 stalks 8 inches long..............	100 Gm.	2.1	0.2	2.7	21	0.025	0.039	1.0	..	+++?	..
Beets........(1)	1½ (2 inches diameter); ½ cup sliced..	100 Gm.	1.6	0.1	9.7	46	0.029	0.039	0.6	+	+	+
String beans..(2)	½ cup cooked......................	100 Gm.	2.3	0.3	7.4	42	0.046	0.052	1.1	++	++	..
D. Gooseberries..(0)	¾ cup...........................	100 Gm.	0.4	..	12.0	50	0.035	0.031	0.5	..	..	..
Raspberries..(3)	¾ cup...........................	100 Gm.	1.7	1.0	12.6	66	0.049	0.052	0.6	..	..	++
E. Kidney beans (0)	½ cup raw........................	100 Gm.	41.1	1.6	42.1	347	0.132	0.475	7.2	+	+++	..
Lima beans...(2)	½ cup raw (dried)..................	100 Gm.	18.1	1.5	65.9	350	0.071	0.338	7.0	..	..	..
	1 cup raw (fresh)..................	100 Gm.	7.1	0.7	20.3	116	0.028	0.133	2.0	..	..	..

A. Substitute for endive (0), watercress (0), chard (0).
B. Substitute for okra (0), parsnips (0), rutabaga (0), spinach (0), turnip (2).
C. Substitute for Brussels sprouts (0), eggplant (2).
D. Substitute for rhubarb, (0).
E. Substitute for lentils (0), fish (?).

[1] Figures in parentheses refer to number of times food appeared as allergen in Rowe's series of 556 incidents of allergy caused by seventy-seven foods among 175 patients.

[2] Includes fiber.

TABLE 28—MENUS FOR DIET 1

	Menu A.	Menu B.	Menu C.	Menu D.	Menu E.
Breakfast:	Rhubarb, 1 cup Mush, white, 1 cup Cornflakes, 1 cup Molasses, 3 tablespoonfuls Coffee, 1 cup Sugar, 1 teaspoonful	Mush, $1\frac{1}{2}$ cups Molasses, 3 tablespoonfuls Dates, 10 Coffee, 1 cup Sugar, 1 teaspoonful Lemonade, 1 glass	Rhubarb, 1 cup Fried mush, $\frac{3}{4}$ cup Bacon, 2 slices Coffee, 1 cup Sugar, 1 teaspoonful Corn pone, 1	Mush, $1\frac{1}{2}$ cups Molasses, 3 tablespoonfuls Dates, 10 Coffee, 1 cup Sugar, 1 teaspoonful Lemonade, 1 glass	Mush, fried, $\frac{3}{4}$ cup Bacon, 2 slices Prunes, stewed, 8 Corn pone, 1 Coffee, 1 cup Sugar, 1 teaspoonful
Lunch:	Lentil soup, 1 cup Lentils, raw, $\frac{3}{8}$ cup Bacon fat, $\frac{1}{2}$ tablespoonful Cornstarch, $\frac{1}{2}$ teasp'nful Parsley, 1 tablespoonful Spinach, raw, 100 Gm. Oil, lemon Corn pone, 1 Stuffed dates, 5	Lamb broth, 1 cup Lamb, raw, $1\frac{1}{2}$ oz. Turnip, $\frac{1}{2}$ cup Cornstarch, 1 teaspoonful Parsley, 1 tablespoonful Corn pone, 1 Rhubarb and $1\frac{3}{4}$ cups cornmeal pudding	Fish chowder, 1 cup Fish, 2 oz. Hominy, fine, raw, 2 teaspoonfuls Parsley, 1 tablespoonful Endive, raw, 100 Gm. Oil, lemon Corn pone, 1 Prune pudding, $\frac{5}{8}$ cup Nuts, $\frac{1}{4}$ cup	Lamb broth, 1 cup As in menu B Corn pone, 2 Endive, raw, 100 Gm: Oil, lemon Lemon whip with nuts, $1\frac{1}{2}$ cups	Lamb pie Lamb, 3 oz. Gravy, $\frac{3}{8}$ cup Cornstarch, 1 teaspoonful Parsley, 1 tablespoonful Mush, 1 cup Endive, cooked, 1 cup Rhubarb sauce, 1 cup Cornflakes, $\frac{1}{2}$ cup
Dinner:	Roast lamb, 3 oz. Mush, yellow, $\frac{1}{2}$ cup Gravy Salad Turnip, raw, $\frac{3}{4}$ cup Nuts, $\frac{1}{4}$ cup Oil, lemon Endive, $\frac{3}{4}$ cup Bacon fat, $\frac{1}{2}$ tablespoonful Stewed corn, $\frac{1}{2}$ cup Corn pone, 1 Lemon jelly, $\frac{1}{2}$ cup	Lentils, 1 cup Bacon, 2 slices Spinach, 1 cup Salad Turnip, raw, $\frac{3}{4}$ cup Dates, 10 Oil, lemon Coffee whip with nuts, 1 cup	Lamb: large lean loin chop, 1 Hominy, $\frac{3}{4}$ cup Gravy Spinach, 1 cup Parsnips, 1 cup Cornmeal and date pudding, $\frac{3}{4}$ cup	Roast lamb, 4 oz. Hominy, coarse, $\frac{1}{2}$ cup Gravy Parsnips, mashed, 1 cup Spinach, 1 cup Oil, 1 tablespoonful Prune-cornstarch pudding, $\frac{5}{8}$ cup	Mackerel, 4 oz. Oil, $\frac{1}{2}$ tablespoonful Eggplant, $\frac{3}{4}$ cup Parsnips, 1 cup Corn pone, 1 Salad: turnip and nuts Cornmeal and date pudding, $\frac{3}{4}$ cup
Standards					
Protein, 70 Gm....	74	68	77	74	78
Fat..............	96	70	85	76	84
Carbohydrate......	337	423	399	401	368
Calories: 2500–2600	2504	2591	2593	2640	2543
Calcium, 0.68......	0.77	0.73	0.69	0.78	0.74
Phosphorus, 1.32...	1.31	1.25	1.35	1.29	1.35
Iron, 0.015........	0.026	0.031	0.023	0.026	0.018
Fruit and vegetables 800.............	735	713	725	715	968

TABLE 29—MENUS FOR DIET 2

	Menu A.	Menu B.	Menu C.	Menu D.	Menu E.
Breakfast:	Stewed raisins, ¾ cup Boiled rice, 1 cup Maple syrup, 3 tablespoonfuls Tea, if desired	Stewed pears, 3 halves Juice, 3 tablespoonfuls Fried rice, 1 cup Maple syrup, 3 tablespoonfuls	Pineapple juice, ½ cup Steamed rice, 1¼ cups Raisins, ¼ cup Tea, 1 cup Sugar, 1 teaspoonful	Apricots, 9 halves Fried rice, 1 cup Maple syrup, 3 tablespoonfuls Tea, if desired	Apricots, 9 halves Boiled rice, 1 cup Maple syrup, 4 tablespoonfuls Tea, 1 cup Sugar, 1 teaspoonful
Lunch:	Green pepper, 1 medium Rice, ½ cup Rutabaga, diced, 1 cup Apricot gelatin, 1 cup Pecans, ¼ cup	Chicken gumbo Chicken, 2 oz. Okra, ½ cup Rice, boiled, 1 cup Watercress, 2 cups Oil, 2 tablespoonfuls Maple tapioca, ½ cup Rice flakes, ½ cup	Chicken soup, 1½ cups Chicken, 3 oz. Tapioca, 1 tablespoonful Sprouts, 2 Rice wafers, 3 Pumpkin, apricot, 1 cup Maple-pecan brittle, 4 pieces 1½ oz.	Chicken loaf Chicken, 2 oz. Gelatin, 1 teaspoonful Pepper, small, ½ Stock Watercress, 1 cup Oil, 1 tablespoonful Rice wafers, 2 Rice-pecan pudding, ¾ cup	Fish gumbo Fish, ⅝ cup Okra, ½ cup Rice, boiled, 1 cup Watercress, 1 cup Oil, 1 tablespoonful Rice wafers, 3 Stewed raisins, ½ cup
Dinner:	Roast chicken Second joint, 1 Small slices, 3 Steamed rice, ¾ cup Swiss chard, 1 cup Rice wafers,[1] 2 Pumpkin-pineapple, 1 cup	Cold chicken, 3 slices Sprouts, 9 medium Rutabaga, mashed, 1 cup Salad: Pepper, ½ medium Pineapple, 2 slices Dressing Rice-raisin pudding, 1 cup	Rice-fish loaf Rice, boiled, ¾ cup Fish, ⅝ cup Pepper, ¼ Oil, 1 tablespoonful Swiss chard, ¾ cup Oil, 1 tablespoonful Rutabaga, mashed, 1 cup Pear whip, 1 cup Pecans, ¼ cup	Fricassee chicken Second joint, 1 Small piece breast Boiled rice, 1 cup Swiss chard, ¾ cup Rutabaga, diced, 1 cup Pineapple-tapioca, ¾ cup	Codfish steak, 5 oz. Oil, 1 tablespoonful Stuffed pepper Rutabaga, mashed, ¾ cup Sprouts, 12 medium Pumpkin-pineapple, 1 cup Pecan-maple brittle, 4 pieces 1½ oz.
Standards					
Protein, 70	69	70	73	69	71
Fat	57	81	76	90	50
Carbohydrate	442	396	430	355	445
Calories: 2500–2600	2548	2609	2564	2543	2541
Calcium, 0.68	0.71	0.70	0.68	0.69	0.67
Phosphorus, 1.32	1.33	1.34	1.24	1.31	1.58
Iron, 0.015	0.021	0.019	0.021	0.021	0.017
Fruits and vegetables, 800	866	901	798	635	980

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[1] Rice wafers are prepared according to the following recipe: Rice flour, ½ cup; salt, ¼ teaspoonful; fat, 1 tablespoonful; water, 2½ tablespoonfuls. Add salt to flour; work in the fat. Add cold water to make a stiff dough. Shape into small flat cakes, place on an oiled sheet and bake in a moderate oven until well browned (about 20 minutes). This amount makes four cakes 2½ inches in diameter. The waters are most palatable when very fresh. Rice flour may be purchased for about 15 cents a pound in any Japanese food store under the name "shinko."

TABLE 30—MENU FOR BOY OF THREE YEARS BASED ON DIET 1

Material.	Measure.	Protein.	Fat.	Carbohydrate.	Calories.	Calcium.	Phosphorus.	Iron.
Breakfast:								
Rhubarb sauce	½ cup	0.5	0.6	30.8	128	0.034	0.024	0.8
Cornmeal mush	½ cup	1.4	0.3	11.3	54	0.003	0.029	0.2
Molasses	3 tablespoonfuls	1.5	...	45.6	189	0.138	0.030	4.8
Midmorning lunch:								
Lemonade	1 tablespoonful juice, 2 teaspoonfuls sugar, 1 teaspoonful molasses	0.2	...	15.4	61	0.018	0.005	0.5
Corn pone	⅔	1.6	2.5	14.3	87	0.008	0.033	0.3
Dinner:								
Lamb roast	1½ ounces, cooked	12.3	10.6	....	144	0.007	0.132	1.9
Parsnips	½ cup, mashed	1.8	0.6	14.9	72	0.065	0.084	0.7
Spinach	½ cup	2.1	0.3	3.2	24	0.067	0.068	3.6
Bacon fat	½ tablespoonful	...	6.0	....	54			
Corn pone	½	1.2	1.9	10.7	65	0.006	0.025	0.3
Prunes, stewed	4	0.8	...	26.9	111	0.020	0.039	1.1
Supper:								
Lentil soup	¾ cup							
Lentils, cooked	⅜ cup	9.7	0.4	22.2	131	0.041	0.164	3.2
Bacon fat	1 teaspoonful	...	4.0	....	36			
Cornstarch	1 teaspoonful	...	...	2.4	10			
Corn pone	½	1.2	1.9	10.7	65	0.006	0.025	0.3
Cornmeal and date pudding	⅜ cup	1.9	2.7	32.1	160	0.056	0.039	2.0
Cod liver oil	1 tablespoonful	...	12.0	.....	108			
Totals		36.2	43.8	240.5	1499	0.469	0.697	19.1
Standards:								
(Weight of boy: 32¼ pounds = 14.7 Kg.)		32.3 (*a*)	44.1 (*b*)		1393 (*c*)	A 0.242 B 0.433 C 0.683	0.332 0.626	10 to 15 mg.

(*a*) 1 Gm. per pound of body weight (Rose, footnote 29).
(*b*) 3 Gm. per kilogram of body weight (Holt, Courtney, and Fales, footnote 30).
(*c*) 43.2 calories per pound of body weight (Gillett, footnote 28).

is added to the test diet, milk and cheese may be given and less insistence need be placed on molasses and leafy vegetables as sources of calcium.

"However, enough vegetables and fruits should appear in the diet at all times to regulate elimination, since Hettwer and Kriz have demonstrated by means of anaphylaxis experiments with guinea-pigs that unusual increase of intra-intestinal pressure as the result of stasis is an essential factor in the absorption of undigested proteins from the alimentary tract. In these menus the amount of bulky foods approximates 800 Gm., the amount recommended at the Mayo Clinic for production of normal elimination.

"Two menus based on Diet 1 (Table 30) are given to show the difficulty involved in providing enough calcium and phosphorus for children from food sources alone. Typical children of three and nine years of age have been considered.

"If the use of Diet 1 relieves symptoms of allergy in the child, milk should be added to the diet experimentally. If symptoms do not reappear, 1 quart of milk a day should be allowed. Molasses and leafy vegetables may be reduced in quantity. However, since they are excellent sources of iron and fair sources of phosphorus, and since the latter are especially valuable for vitamin A, they should not be eliminated from the diet entirely.

"If the child is sensitive to milk, immediate measures should be taken to enable him to use this essential food. Desensitization by feeding has not been successful in Rowe's hands; Sanford, also, has not had marked success in attempts to desensitize, although he uses the method of feeding small amounts with gradual increase in dosage when the allergen is wheat. Many other investigators have reported success in using oral desensitization measures.

"Disturbances of the gastro-intestinal tract should be guarded against, since they augment the possibility of absorption of undigested protein.

"Denaturation of the milk protein by boiling may be helpful in some cases. Schloss finds it so. Wells, dealing with true anaphylaxis in guinea-pigs, found that heating milk to 100 C. for twenty-five minutes did not destroy its intoxicating effect.

"If boiled or pasteurized milks are used, their coagulability by rennin will be diminished. This is sometimes advantageous. Hill has found that the curd of unboiled milk is approximately three times as hard as that from boiled milk. If it is considered disadvantageous, coagulability may be restored by addition of calcium chloride or hydrochloric acid.

"Milk may be given in the form of junket, if there is any question of its coagulation in the stomach. Sansum, in discussing food sensitization, states that rennin is rarely absent from the stomach. However, optimum acidity for its action may not obtain, the range for activity being given as *p*H 6.3 to *p*H 6.0 by Faber. In this case unaltered milk proteins may be carried into the intestine with consequent opportunity for their absorption before digestion.

"Milk acidified by the action of lactic acid bacteria or by the addition of acid may be used. With many individuals, such milk undergoes more complete gastric digestion than does fresh cow's milk. Peptonized or pancreatinized milk may also be used. Sansum administers pancreatin tablets (enteric coated) to increase rapidity of digestion in the intestine.

"Sometimes a food taken in large quantity or taken by itself will produce symptoms of allergy, whereas it is ineffective when taken in small amounts or with other foods. For this reason better results may be obtained if a small amount of milk, preferably dried, is mixed thoroughly with cereal and the mixture is then well cooked in water and served without additional milk."

The above measures may be supplemented by acidophilus milk by mouth, colon irrigations, or implantations of Bacillus acidophilus *per rectum*. Even in the absence of constipation, castor oil and salol capsules, or small doses of salines or calomel, are useful. Sodium thiosulphate injections given intravenously have been recommended by Throne *et al.* to establish a proper balance between the chlorides and the sugar in the skin, in the belief that the pruritus is associated with a deposition of carbohydrate in the cells of the skin. Calcium chloride has been employed successfully by some, and insulin has seemed beneficial in the hands of Zuviria. In nervous patients, bromides are frequently indicated. Subcutaneous injections of spleen liquid, as recommended by Paul, are occasionally beneficial.

x-Ray Therapy.—There is no disease in which more remarkable results are accomplished by *x*-ray treatment. Four to six fractional exposures almost invariably cause the involution of lesions. Although roentgen therapy is not curative in all cases, the results are often permanent. Tullio reports 184 cures from a total number of 337 cases, and Lomholt, 58 permanent recoveries in 168 cases treated at the Finsen Institute. Eichenlaub, from a study of 100 cases, found that on the average three treatments were required for each case. In isolated instances I have cured eczema of ten or more years' standing by a single exposure of a few seconds. In the majority of cases, however, the treatment is solely symptomatic, relieving the itching and causing involution for a period of six to ten weeks.

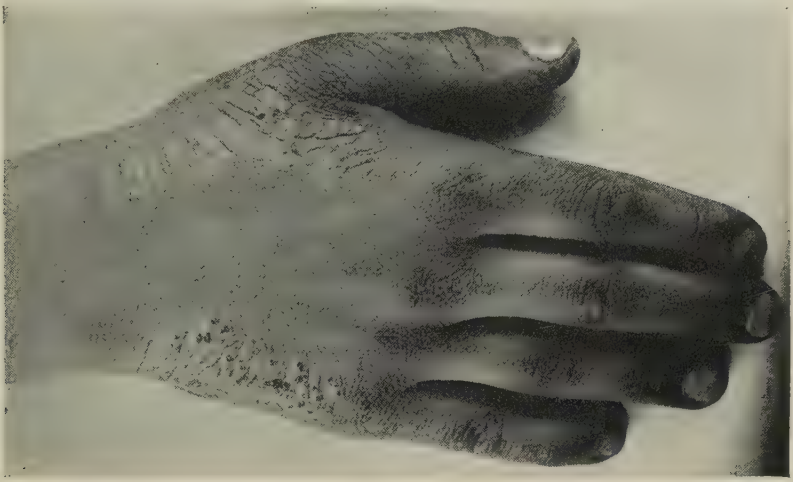

Fig. 239.

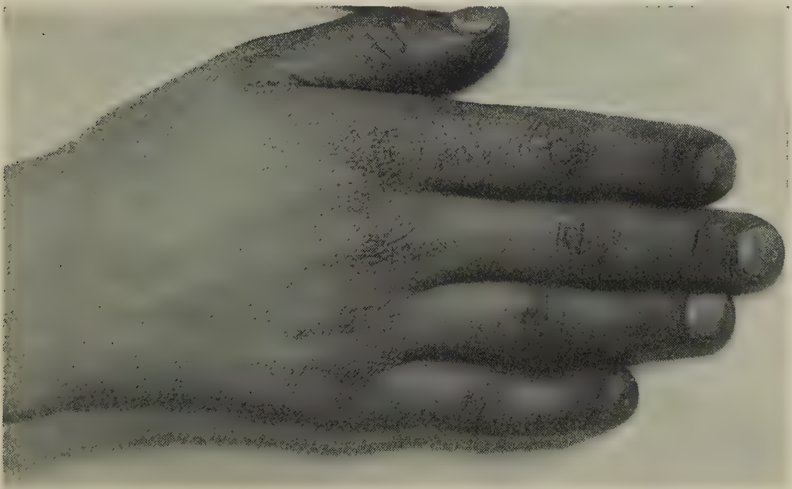

Fig. 240.

Figs. 239, 240.—Lichenified eczema of the hand. Before and after three fractional doses of x-rays.

Although radiation is generally conceded to give the best effect in subacute and chronic types of the disease, Bormann believes that the roentgen therapy of acute eczema also has a sound theoretical basis. His report comprises 400 cases treated during a period of eighteen years. The author has likewise frequently obtained good results in the acute stages and does not believe such treatment is contraindicated. Roentgen therapy is so much superior to other measures that it is the method of choice in chronic eczema, where it gives results that cannot be duplicated by other local applications, with a sureness and rapidity that are very gratifying.

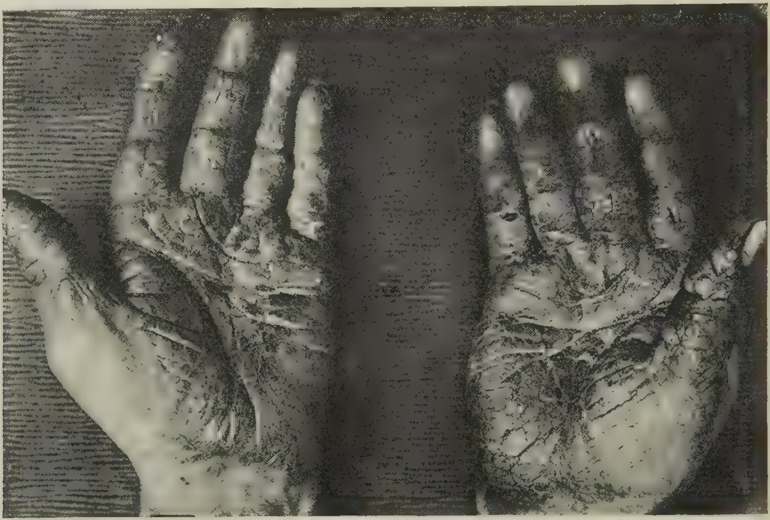

Fig. 241.

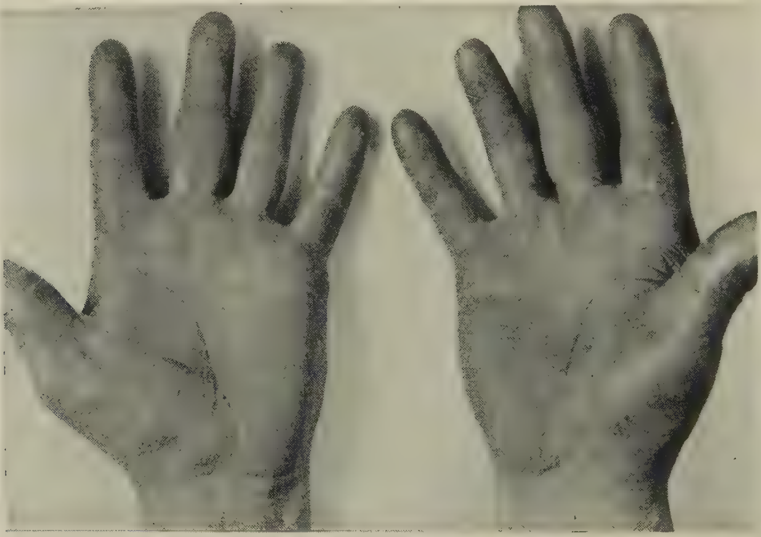

Fig. 242.

Figs. 241, 242.—Eczema palmaris. Before and after *x*-ray treatment.

The dosage should always be below an erythema, usually fractional—$\frac{1}{4}$ E. D. repeated at weekly intervals. In acute types this latter dose should not be exceeded, and smaller amounts ($\frac{1}{8}$ or $\frac{1}{16}$ E. D.) may be advisable on account of the youth of the patient, the location of the lesion (hairy parts, lips, mammae, and mucosae), and a history of previous radiotherapy, or the use of strong local remedies. When the lesions are subacute or chronic, a larger dosage is permissible unless the eruptions are very extensive. Circumscribed lesions may be given ½ to ¾ E. D. repeated every three or four weeks.

When the lesions are widespread the technic for generalized eruptions should be followed, the body surface being divided into sections which are treated serially or on successive days. Failure to observe this precaution may lead to a severe constitutional depression, nausea, headache, or syncope.

Although unfiltered radiation usually gives as satisfactory results as when filters are used, this does not hold in the treatment of thickly crusted or lichenified patches. For this type of lesion, filtration through 3 mm. of aluminum is advocated.

In conjunction with radiation treatment, the removal of internal and external causative factors and the prescription of diet, mild local applications, and internal medication are advocated. The local applications should be soothing in the acute forms of the disease and stimulating when the lesions are chronic. After roentgen treatment has caused all lesions to involute, a course of generalized ultraviolet exposures to produce deep tanning has in my experience seemed to diminish the likelihood of recurrences.

In the *erythematous stage* I have found *x*-ray treatment beneficial although I am aware that it is considered contraindicated by some. The dosage should be subfractional. The improvement is not immediate, but as in other diseases treated by *x*-rays, ensues after a latent interval, which in the case of eczema is only three or four days. I have irradiated exceedingly acute edematous eruptions and have never noticed any aggravation of the disease which could be attributed to the roentgen therapy.

Cold cream or olive oil should be used as substitutes for soap and water in cleansing the affected areas. Cool wet astringent dressings and lotions and powders reduce the congestion and swelling. It is advisable to begin with continuous wet dressings of milk containing one to three teaspoonfuls of liquor plumbi subacetatis applied on a mask made of surgical lint. The mixture should be kept cold in a covered enamelled cooking pot surrounded by cracked ice in a pan. The mask is wrung out in it and applied to the face, being held in place by tapes about the head. Small gauze compresses are now wrung out in the ice-cold mixture and laid on top of the mask, being changed continually until the heat of the inflammation subsides. After the milk has been used for one or two days, an emulsion of olive oil, 10 per cent; tragacanth, 1 drachm, and lime water, 1 pint, is substituted for it. To this emulsion, small amounts of liquor plumbi subacetatis may be added (ʒj to Oj). Unna's soft zinc paste (pasta zinci mollis, U. S. P.) is beneficial. In addition to the following well-known calamine lotion containing phenol and menthol one may use a weak solution of ichthyol, or olive oil, or olive-calamine liniment (formula on page 281).

℞.	Calamin. praep.,		
	Zinci oxidi	āā	℥ij
	Phenolis		ʒj
	Mentholis		gr. x
	Glycerini		℥ij
	Aq. hamamelidis	q.s. ad.	℥viij

M. and S. Apply locally every hour.

These should all be applied as continuous ice-cold, wet dressings with a mask.

In the *papular* and *vesicular* stages the influence of radiation is conspicuous, the lesions involuting rapidly after fractional doses. Circumscribed patches and diffuse eruptions should be treated by ¼ E. D. at weekly intervals. During radiotherapy the itching should be relieved by lotions containing phenol, liquor carbonis detergens, menthol, camphor, or tincture of benzoin.

℞.	Liq. carbonis detergent	ʒj
	Glycerini	ʒij
	Zinci oxidi	℥ss
	Liq. alumini acetatis	℥iij
	Aq. hamamelidis q.s. ad.	℥viij

℞.	Phenolis	℥j
	Tinct. benzoin comp	℥j
	Glycerini	℥ij
	Spt. vini rect	℥ij
	Aq. camphorae q.s. ad.	℥viij

Mix the benzoin in alcohol and gradually add the other ingredients. Shake; label: Sig: Apply affected areas q. 3 h. with small sponge.

When the exudation is slight, Lassar's paste with or without 2 per cent salicylic acid or 5 per cent naftalan is of value.

In the *pustular stage* the results from roentgen therapy are usually spectacular, but occasionally the lesions may be recalcitrant. Much seems to depend upon the virulence of the secondary infection and the resistance of the patient. The dosage should be fractional except on the scalp or hairy parts, where no more than ⅛ E. D. weekly should be administered during a period of four weeks. When impetiginous eczema of the scalp and face is usually first seen, the parts are covered by crusts. These should be softened by borated petrolatum, after which wet dressings and sedative antiseptic lotions are indicated. Acriflavine, 1 : 1000; potassium permanganate, 1 : 5000; liquor plumbi subacetatis or liquor alumini acetatis (Burow's), either diluted 1 : 10, is a desirable dressing. Ammoniated mercury ointment is also beneficial, but the fact must be kept in mind that some eruptions are intolerant to greases.

In the *crusted and thickened stages* the lesions invariably respond well to radiation although stubborn to therapy by other means. The dosage should be fractional or semi-intensive but always kept below an erythema. The usual technic is to give ¼ E. D. at weekly intervals, ½ E. D. biweekly or ¾ E. D. at intervals of three weeks. This therapy causes a rapid disappearance of the pruritus and involution of the lesion. Fuhs mentions that only the old hemorrhagic type of eczema on the lower part of the leg on a varicose base and the tylotic and rhagadiform affections of the palms and soles seem refractory. The scabs should be softened with olive oil and removed before mildly stimulating and antiseptic ointments are applied. In the chronic lichenified and squamous stages an ointment of 5 per cent salicylic acid, tar, sulphur, or mercury gives the best results, and in this strength is usually tolerated with fractional or semi-intensive *x*-ray treatment. A combination consisting of 5 or 10 per cent each of tar, salicylic acid, and sulphur is extremely beneficial, but its combined use with fractional roentgen therapy should be restricted to those cases in which a tolerance to the ingredients has been shown. Caution is necessary in combining local medicinal stimulants with *x*-ray therapy as they augment the effect of one another. Tar, sulphur, mercury, resorcin, chrysarobin, and salicylic acid should never be used in strong concentrations simultaneously with large doses of x-rays, but may be used in weak strength with fractional roentgen dosage, or, when the tolerance has been gradually determined, with semi-intensive treatment (see page 134). In cases where there is no hope of permanent cure of the disease by x-rays, the irradiation should be mild and with ample intervals to avert all possible danger and permit the liberal use of local medicines. The total collective fractional dosage on any one area, even with long intervals between treatment, should never exceed 3 E. D.

In some cases x-rays have been used upon the thyroid gland, ovaries or other glands of internal secretion to secure a general effect. This form of therapy is still in the experimental stage, and the results so far obtained do not instil much confidence. Radicular radiotherapy has occasionally given relief to regional eczema.

Ultraviolet Therapy.—This form of radiation is a valuable therapeutical agent in the subacute and chronic phases of eczema, but is contraindicated in the acute types. The persistent varieties which are so often associated with staphylococcus and streptococcus infections respond better to this form of treatment than to any other, possibly because of the bactericidal action of the rays upon the profuse numbers of cocci, which are so easily demonstrated on the skin, and because of the increased blood supply to the part. Lomholt has reported cases of chronic eczema which became intractable to x-rays and other methods of therapy and responded only to ultraviolet treatment. The author has had two similar cases and in each the eruption seemed to have been caused by an allergy of the patient to profuse numbers of cocci on the skin. Similar benefits are obtained in pustular eczema and in infectious eczematoid dermatitis. Lomholt has noticed that relapses are seldom localized to the original position of the patch and believes the radiation increases the local resistance. He has reported 60 per cent of his patients completely cured; of the remaining 40 per cent about 25 per cent were more or less improved. In no instance was the condition aggravated by the treatment. Excellent results were obtained in lichenified and keratotic patches of long standing because of the antipruritic and regenerative effect of the radiation.

Treatment should be generalized as well as local, the dosage being suberythema or erythema over the body, and a second degree erythema over the affected area. Exposures should be repeated two or three times weekly.

Radium Therapy.—In the acute or widespread eruptions of eczema radium is useless, but it is extremely valuable in the treatment of fissured, crusted, and lichenified patches, especially upon locations difficult to treat by roentgen rays. I have found it particularly useful on the scalp, eyelids, in and about the ears and genitals, and between the toes. On these areas unfiltered radiation should be used, derived either from a flat unscreened applicator or a glass tube or bulb containing the salt or emanation. The applicator is held in contact with the lesions for an exposure sufficient to produce clinical improvement without an erythema or epilation. With half-strength applicators from four to ten minutes' duration is sufficient, and the dosage for a glass tube or bulb should be about 40 mc. minutes per square centimeter. Tubes are preferable on the fissured lesions which occur about the ears, in the auditory canal, or between the toes. On flat surfaces fairly equal distribution of tube dosage can be obtained by first coating the area with vaselin and then moving the tube to and fro over it, a wooden spatula being used for a handle. This method is a makeshift and applicable only in special instances.

Radium has no influence upon the general course or cure of eczema. It should be used only with caution and by those who have had experience.

Treatment of Regional Types of Eczema.—Although the manifestations of eczema are likely to vary in different locations due to exposure, friction, moisture, and anatomical differences of the skin, the treatment of each region is founded upon the general principles already outlined. The following paragraphs will describe certain modifications which are desirable under special conditions.

Eczema of the *scalp* may be acute or chronic, and in the former stage may be very exudative and crusted. The oozing is controlled in a spectacular manner by subfractional *x*-ray therapy, the dosage always being maintained below $\frac{1}{2}$ E. D. to avoid a defluvium. It is customary to give $\frac{1}{8}$ E. D. once or twice weekly until the total dosage equals $\frac{1}{2}$ E. D. This dosage is administered to each of the five points treated with the Adamson-Kienböck method described in the chapter on Tinea Capitis. The course of treatments may, if necessary, be repeated after a rest interval of six weeks.

The *w*-rays are efficacious and ideally suited for the treatment of acute eczema of the scalp because there is practically no danger of a defluvium from their reasonable use, with a set-up of 8 kv., 8 ma., and an anode-skin distance of 10 cm. The exposure should be of two minutes' duration and repeated twice weekly, seven placements being made—two on each lateral aspect—instead of the five suggested in the preceding paragraph.

Crusts should be removed by oil or cold cream, and subsequently washed off by soap and water. It is often desirable to cut off the hair. In acute oozing eruptions, ice-cold wet dressings of 10 per cent emulsion of olive oil, tragacanth, and lime water containing 1 per cent phenol may be applied. Exudative areas should be painted with silver nitrate solution, followed by a sedative or slightly stimulating lotion or cream.

℞.	Liq. carbonis detergent.	
	Phenolis	āā ʒss
	Ol. ricini	ʒiij
	Glycerini	ʒij
	Liq. alumini acetatis (Burowii)	℥ss
	Aq. camphorae,	
	Aq. calcis	āā q.s. ad. ℥viij

M. and S. Shake and apply freely to scalp t. i. d.

℞.	Sulphur praecip	ʒij
	Stearin	℥iss
	Petrolat. liquid	℥j
	Sodii borat	gr. xx
	Potassii hydroxidi	gr. xxiv
	Aquae destillat	℥viiss

M. and S. Scalp cream. Rinse off with hot water.

In the chronic type *x*-ray treatment is rarely necessary or advisable. When applied it invariably gives relief but usually this is temporary, and it is dangerous to treat each recurrence with *x*-rays unless one does not object to a defluvium. The *w*-rays may be used with perfect safety and are recommended because they are very beneficial. The technic should be the same as that just described for the acute stages of the disease, and the dosage may be slightly augmented. The *w*-rays are far more effective than the ultraviolet rays in chronic eczema, the latter being, nevertheless, widely used on the scalp. Distance radiation with the mercury or carbon arc lamp should be administered twice weekly in erythema doses to the front, back, sides, and top of the scalp. Stimulating lotions and ointments, preferably containing salicylic acid and oil of cade, should be used in conjunction with the ultraviolet or *w*-ray treatment, and when properly modified are also permissible with subfractional *x*-ray therapy.

The *nape of the neck* is a frequent site of eczema, which is usually of the chronic lichenified variety. The occasional acute exudative eruptions should receive treatment such as described for similar conditions on the scalp. It is most important to relieve the itching of the chronic lichenified lesions (neurodermatitis) promptly. The best results are derived from *x*-rays given in fractional weekly exposures, and generally the pruritus disappears after the first or second week of treatment. It must be remembered that persistence in the application of this dosage may lead to epilation, especially if there is any overlapping of areas. It is, however, safe, when the occiput is shielded, to give ¼ E. D. weekly to the back of the neck for four successive times and this allows more than is usually required for complete relief of the condition. *w*-Rays are less effective than *x*-rays, requiring exposures twice weekly in doses one quarter as large as that which provokes an erythema. Ultraviolet radiation is even less useful in the average case, although in isolated instances very good results follow its application.

Topical remedies for the relief of itching are preferably lotions or creams.

℞.	Liq. carbonis detergent.	
	Phenolis	āā ʒss
	Mentholis	gr. v
	Spt. vini rect	℥j
	Ol. ricini	ʒij
	Aq. camphorae	q.s. ad. ℥iv

M. and S. Apply often enough to allay itching.

℞.	Mentholis	gr. v
	Sulphur praecip	gr. xv
	Naftalan	ʒj
	Phenolis	gr. viij
	Petrolat. liquid	℥j
	Cerae albae	ʒij
	Sodii borat	gr. vj
	Aquae destillat	ʒiv

M. and S. Apply morning, noon, and night.

Eczema of the *face* is usually of the acute erythematous type, with symmetrical redness and swelling, which suggests erysipelas. At this stage catharsis and local sedative applications are most important, but in addition it is desirable to apply subfractional doses of *x*-rays to each cheek, and occasionally also to the forehead. After the acute stage has passed roentgen therapy becomes of increasing importance for the control of the squamous infiltrated lesions of chronic facial eczema. When this stage is reached *x*-ray dosage may be fractional, with ¼ E. D. to each side of the face weekly. *w*-Rays and ultraviolet rays in average doses are irritative during the acute stages, but are of some benefit later.

Local applications should be soothing oils or creams until the acuteness subsides, when stimulating ointments may gradually be instituted.

℞.	Phenolis	gr. xx
	Ol. olivae,	
	Petrolat. liquid	āā q.s. ad. ℥viij

M. and S. Apply locally on lint as wet dressing.

℞.	Liq. alumini acetatis (Burowii)	ʒij
	Phenolis	gr. vj
	Ung. aquae rosae	ʒiij
	Adipis lanae	℥j

M. and S. Apply to affected areas freely.

Use after acute stages have subsided:

℞.	Liq. carbonis detergent	gtt. v
	Hydrarg. ammon	ʒss–ʒj
	Ung. aquae rosae	q.s. ad. ℥j

Use in dry type:

℞.	Acidi salicylici	gr. x
	Petrolati albi	℥j

The *eyebrows* are often involved when eczema affects the face. The treatment requires special care to avoid epilation, or injury to the eyeball. Radiation therapy is best accomplished by the *w*-rays or unfiltered radium. With either method the eyeballs should be protected by lead foil. With the use of the *w*-rays the best technic is an exposure of four minutes at 8 kv., 8 ma., and an anode-skin distance of 8 cm., which is just below an erythema dose. This should be repeated once weekly, each eyebrow being exposed separately. The flat glazed radium applicator is well adapted for use in this location. It is applied without a screen and in direct contact with the lesion, for a little less than an erythema exposure. With a half-strength salt applicator exposures of four to eight minutes may be repeated every two weeks until the lesions have involuted. Frequently, one application is sufficient. Roentgen rays produced by the ordinary therapeutic apparatus may be cautiously used in subfractional doses. By employing 100 kv., unfiltered, 3 ma., and 8-inch anode-skin distance, about $\frac{1}{8}$ E. D. will be given by an exposure of fifteen seconds' duration. This dose may be repeated weekly four successive times, after which an interval of at least one month should elapse unless epilation is warranted. In addition to radiation therapy local treatment consists of the removal of the crusts by olive oil and the application of a mild ointment or cream containing boric acid, yellow oxide of mercury 2 per cent, naftalan 3 per cent, or ichthyol 5 per cent.

Eczema of the *eyelids* is commonly secondary to scalp eczema, and treatment of the scalp is of primary importance, as it is impossible to prevent recurrences on the eyelids until the former is free from the affection. At first the areas are puffy and later become crusted. After the swelling has subsided under an astringent:

℞.	Camphorae	gr. ss
	Liq. alumini acetatis	ʒij
	Petrolati liquidi	ʒss
	Adipis lanae	℥j

M. and S. Use freely on the eyelids.

and crusting has commenced, the lids may be treated by *w*-rays or the beta rays of radium with one half the doses suggested for the eyebrows. Ointments containing boric acid or 1 per cent yellow oxide of mercury may be used simultaneously with radiation treatment.

The *nose* is frequently involved, especially the alae or the adjacent mucosa. It is important to cure these lesions as they are often the portals through which facial erysipelas starts. Fissures should be painted with silver nitrate or treated with strong tar or ammoniated mercury ointments. When secondary to septic nasal discharges the latter should be eradicated and autogenous vaccine injections should possibly be given. In recalcitrant cases permanent relief is usually given by radium, an unfiltered glass tube containing the salt or emanation being used. Such a tube is held in contact with the fissure, being applied on the end of a wooden applicator. A dose of 400 to 500 mc. minutes will produce a sharp reaction, which is desirable. The actual cautery when properly applied will produce similar results, but its use requires a local anesthetic.

Eczema of the *bearded region* is often secondary to other local affections. In both the exudative and scaly stages radiation is beneficial. The technic should follow that outlined for sycosis vulgaris with fractional doses. Simultaneously, internal treatment directed against eczema should be instituted according to indications.

The *lips* may be involved alone or conjointly with other parts of the face. Local causes may be pyorrhea, nasal discharge, tooth powder, lipstick, or smoking. When the cause can be discovered it should be removed. The *w*-rays and ordinary *x*-rays are beneficial. With the former a mild erythema may be produced without cause for anxiety, but with the latter the dosage should always be subfractional, as suggested for eczema of the eyebrows. The mouth should be partly open and the remainder of the face carefully shielded. In some instances it is permissible to give $\frac{1}{4}$ E. D. weekly for three exposures, but the sensitiveness of the lips must be kept in mind in order to prevent an erythema. Ultraviolet light is also helpful in subacute or chronic eczema of this location. It should be applied twice weekly in erythema exposures. Bland diet, alkalinization, and elimination are of accessory importance, and the mouth should be kept in a hygienic condition. A useful application is glycerite of tannin containing small amounts of camphor, menthol, and phenol. Fissures should be painted with silver nitrate or compound tincture of benzoin.

Eczema of the *ears* may attack the helix, the external auditory canal, the postauricular fold, the lobes, or beneath them. The scalp should always be examined for evidences of a similar condition or pediculosis. The early stages are frequently edematous and later the lesions become crusted, fissured, or rugose. Ordinary fractional roentgen therapy is extremely beneficial. When the area involved is behind the helix or beneath the lobe the organ should be held forward or upward by adhesive tape so as to expose the affected zone. When the involvement extends into the external auditory meatus filtration is advisable. A good technic consists of 140 kv. (9-inch spark gap), 5 ma., 10-inch distance, filtered through 3 mm. of aluminum, exposure time of four minutes, with proper shielding of the scalp and eyes. The patient should lie flat on his back, with head rotated as far as possible. A small pillow inserted beneath the shoulders or the head will often aid in bringing the area into good position. The exposure is made through a hole the size of the ear cut in a piece of sheet-lead large enough to cover the side of the head. Treatments may be repeated every two weeks, an erythema always being avoided. Usually one or two exposures are sufficient to cure the condition, but if progress is slow no more than four exposures should be given without a rest interval of two months. In recalcitrant cases radium may be employed. When there is a diffuse involvement of the canal a tube filtered through 0.5 mm. of silver, enclosed in rubber, may be inserted within the orifice for 50 mc. hours. When the involvement is limited and especially when there is fissuring, a bare glass tube containing the element or emanation may be held in contact with the area for 200 to 300 mc. minutes.

Cerumen and scales should be removed from the canal, sweet almond oil being used to soften them; irrigations should be avoided.

Conjointly with radiation therapy the following ointments are beneficial and may be modified to suit the individual case:

When acutely swollen—

℞.	Liq. alumini acetatis (Burowi)	℥ss
	Petrolat. liquid	ʒss
	Phenolis	gr. x
	Adipis lanae	℥j

During subacute or chronic stages—

℞.	Ol. rusci	ʒss–ʒj
	Sulphur praecip	gr. x–xx
	Phenolis	gr. v
	Ol. amygd. dulc	ʒj
	Adipis lanae	q.s. ad. ℥j

Eczema of the *breasts* may affect the areolae, the skin, or the folds beneath. Involvement of the areolae is often painful due to fissuring. There is a tendency for this affection to be obstinate, being secondary to chemical changes in the secretions of the Montgomery or lacteal glands. Cases of long standing should be examined clinically and histologically for evidences of Paget's disease. If there is any infiltration or induration, microscopical examination is advisable, and in the presence of any dyskeratosis radical therapy should be considered. This is described on page 932, chapter on Cancer. Eczema of the nipples does not respond well to local medicines but is benefited markedly by radiation, which should be soft enough to avoid injury to the glandular tissue. The *w*-rays are ideally suited to this purpose. An exposure of six minutes' duration, with 8 kv., 8 ma., at 10 cm. anode-skin distance may be repeated once weekly. Usually two or three treatments

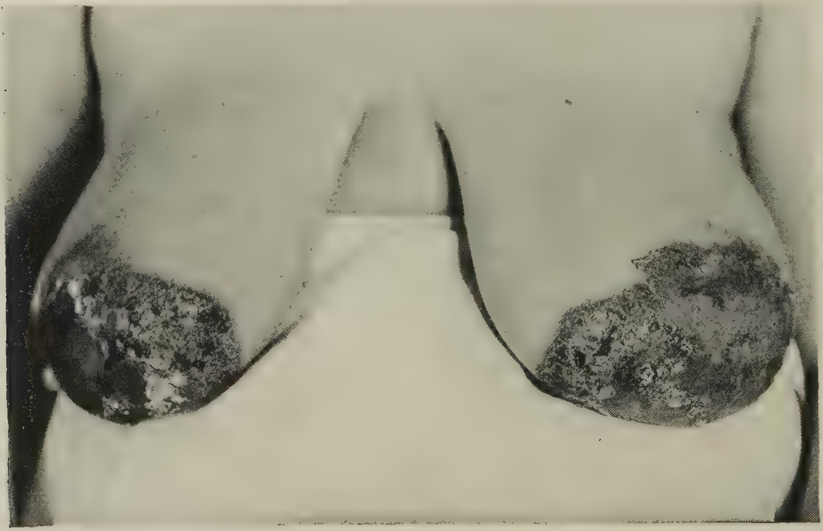

Fig. 243.—Eczema of the nipples. (Courtesy of Dr. Lewis B. Robinson.)

are sufficient to complete involution. Eczema of the areolae, the skin and the folds beneath pendulous breasts may also be treated by the quality of x-rays ordinarily used in dermatological therapy, $\frac{1}{4}$ E. D. being given weekly. The exposure should be limited to the affected area by careful shielding of contiguous parts. Although fractional x-ray treatment is efficacious in clearing up these lesions, it is not advisable if the eruptions can be cured by any other method. The predisposition of the breast to malignant changes is probably not materially enhanced by small doses of unfiltered x-rays required to cure eczema of the nipple and skin, but as there is some doubt it precludes the free use of this form of therapy for such purpose. Tullio reports 46 cases of eczema of the breasts treated by x-rays. He had 32 cures and only two recurrences, 10 cases still being under treatment. Bellucci treated 50 cases of chronic moist eczema of the nipple and areolae following scabies. All had resisted other forms of therapy. In about 30 of the cases he irradiated the eczematous area directly and in other cases the ovaries or thyroid on the theory that eczema is an endocrine disturbance. All of the cases treated directly were completely cured in about three weeks.

During the acute phases soothing lotions are desirable, but in the crusted, fissured lesions oil of cade 3 to 6 per cent in Lassar's paste is frequently of value.

The *axillae*, *groins*, *umbilicus*, and *gluteal* crease may be affected in association with generalized eczema or secondarily to local pruritus, or to local mycotic or pyogenic infection. Generally the eruption will involute in a few days as the result of medicinal applications, but when the lesions are persistent fractional roentgen therapy is extremely efficacious. The technic for exposing these areas has been described on pages 125 and 127. Ultraviolet rays are beneficial in mild cases. Crusts should be removed by olive oil, after which mild ointments containing salicylic acid or ammoniated mercury are applied.

Eczema of the *arms* and *legs* often has special characteristics which should be recognized, as they modify the treatment. The antecubital and popliteal spaces become lichenified due to rubbing, as there the skin is thin and subjected to friction in movement of the joints. The forearms are prone to involvement in the eczematous forms of occupational dermatitis, usually in association with the hands. On the legs varicose veins and hemostatic conditions produce special features such as marked edema, purpura, pigmentation, and ulceration. Secondary infection associated with lymphangitis and mild attacks of recurrent erysipelas eventually cause a condition of elephantiasis. In addition to the above changes of circulatory origin, eczema of the legs may be secondary to parasitic affections of the feet or caused by dyes in the shoes or stockings.

The treatment of these conditions should follow the general plans already outlined in the preceding pages. Friction of clothing upon the joints may be diminished by painting the areas with zinc gelatin and by covering with a bandage or stocking. Varicosities, infections, and ulcerations should be treated according to surgical principles. Physiotherapy is nearly always beneficial as a supplement to other forms of treatment. Fractional doses of unfiltered x-rays relieve the pruritus, diminish exudation or thickening, and at times hasten the healing of chronic ulcerations or favorably influence the hyperplasias. The benefits of ultraviolet radiation are similar to those of x-rays, but less certain. Ultraviolet therapy is specially indicated when there is secondary infection or indolent ulceration. Local treatments should be supplemented by generalized exposures, to influence favorably the metabolism, resistance, and blood calcium content.

The *hands* and *feet* are frequently affected by eczema, sometimes in association with a general cause, but more commonly due to local irritants encountered in industry. The eczema is occasionally secondary to parasitic infections. All phases of the disease may exist, ranging from the very acute, exudative form to keratotic, fissured lesions.

Roentgen therapy is beneficial in all stages, but must be administered cautiously to obtain satisfactory results. The technic of exposing the hands and feet to radiation has been described on pages 126 and 127. In particular, attention must be paid to the interdigital spaces, which are likely to be insufficiently radiated, and to the thenar eminence and thumb, which are likely to be overtreated. Proper focusing will diminish the former error to a minimum, and cautioning the patient to maintain complete radial eversion of the hand during treatment of the palm will offset the other contingency. Some cases are so refractory that it is advisable to stop the *x*-ray treatment after a protracted trial so as to avoid atrophic sequelae. The dosage should always be fractional or semi-intensive, and well below an erythema. Brown has offered some evidence in favor of semi-intensive doses—$\frac{1}{2}$ E. D. every two weeks instead of $\frac{1}{4}$ E. D. weekly. From a study of 100 cases he concluded that by the former method the percentage of cures obtained is slightly greater and the percentage of relapses less than those resulting from the smaller weekly dosage.

Eczema of the *fingernails* and *toenails* may or may not be associated with eczema of other parts of the body. The adjacent skin is usually affected, being red and swollen or dry and cracked. The nails become malformed with irregular ridges and depressions, and the free margins cracked, thickened, everted and discolored. Generally more than one nail is affected. It is impossible on clinical grounds to differentiate eczema of the nails from onychomycosis. For this reason, cultures and examination of smears in liquor potassii should be made in all instances (see page 545).

Treatment is usually protracted but successful. In subacute and chronic cases *x*-ray therapy is the method of choice. It is preferable to expose the fingers of each hand separately and make another exposure for the thumbs. The anode-skin distance should be sufficient to give a homogeneous distribution over all nails exposed, while the proximal parts of the fingers should be shielded. The exposure may be filtered or unfiltered, as there is no difference in the clinical results. The dosage must always be fractional, never approaching an erythema, preferably $\frac{1}{4}$ E. D. weekly.

The *genitals*[1] are frequently affected and often from some local cause. The disease must be differentiated from parasitic infections.

In males the prostate, seminal vesicles, and urine should be examined, and stones of the kidney and bladder should be excluded. Eczema of the *scrotum* is usually associated with intense pruritus, which tends to be spasmodic. Every effort should be made to obtain a cure by discovering the cause, by local remedies, diet, alkalinization, and increased elimination. When these measures fail the area should be treated with *w*-rays or the soft radiation from a flat glazed unfiltered radium applicator. Ordinary roentgen therapy is objectionable because the testicles are so radiosensitive, and it is questionable whether penetration is not sufficient to cause some injury.

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[1] See also Treatment of Pruritus Ani et Scroti, and of Dermatitis Venenata.

Although ultraviolet light is rarely beneficial in the treatment of eczema of the scrotum, the shorter wavelengths of the *w*-rays are invariably beneficial, and because the latter are comparatively harmless they may be applied liberally. The technic consists of 8 kv., 8 ma., with a skin distance of 6 cm. for an exposure of four minutes' duration. Irradiation from this distance produces a beneficial action upon a field approximately 4 cm. in diameter. When the involved patch is larger, more than one field should be irradiated, with overlapping allowed. Treatments should be repeated every seven days until there is visible improvement or reaction, when they should be given less often, usually two or three treatments sufficing to cure the condition.

When the *w*-rays are not available, eczema of the scrotum may be treated with soft radium rays. The diseased area may be covered by a half-strength flat applicator used on successive fields, without screening, for an exposure time of fifteen minutes' duration to each. These treatments may be repeated every ten days over a period of one or two months, if necessary. To cure the condition generally requires two or three treatments. When the lesions are lichenified or thickly crusted, exposures of thirty minutes may be preferable, with a screen of 0.2 mm. aluminum.

When neither of these superficial types of radiotherapy is available, ordinary unfiltered roentgen therapy may be applied, the softest quality of radiation being desirable. Because of the small dose necessary to effect a cure and because radiation of the testicles can usually be avoided by placing them in the inguinal canals or holding them out of the way where they may be shielded, roentgen treatment of this condition is not absolutely contraindicated. When the scrotum is large it can be manipulated with clamps or held by the patient's fingers so that the testes may be shielded from the irradiation. Such manipulations are not always possible or practicable. In all events the patient's fingers and testes should be shielded so far as is possible, and care exercised not to overlap the exposures on the lower anterior surface of the scrotum. Subfractional dosage of $\frac{1}{8}$ E. D., unfiltered, applied to each side of the scrotum for three or four weekly exposures usually gives decided relief in obstinate cases.

Where the eczema is largely situated on the anterior surface of the scrotum, immediately under the penis, the areas can well be irradiated by one exposure, thereby eliminating the danger of overlapping. When the posterior part of the scrotum near the perineum is involved, the thighs are flexed upward and outward so as to expose the part. In focusing the tube it is necessary to make certain that the distance from the tube to the scrotum is shorter than that to the inner thighs, unless a metal cone is used. This precaution is sometimes overlooked in the treatment of scrotal and vaginal lesions, consequently resulting in *x*-ray burns of the inner thighs.

Locally, calamine and zinc lotion, Lassar's paste, and Burow's solution in anhydrous lanolin are frequently beneficial. To these preparations small amounts of phenol or camphor may be added to relieve the itching, and in cases of long standing small amounts of sulphur and tar are remedial.

Eczema of the penis usually produces marked swelling and intense pruritus. The condition responds better to local astringent preparations than to physiotherapy.

When the vulva is affected by eczema there may be a local cause of chemical or parasitic nature, or an association with eczematous patches elsewhere. Frequent local causes are glycosuria, irritating vaginal discharges, irritation from douches, prophylactics, or deodorants placed in the napkins. Contraceptives and changes in the local secretions due to pregnancy or fetal death must be considered as causative agents. As a result of rubbing and scratching for the relief of pruritus vulvae the skin may become eczematized, and the treatment should be directed against the cause, as given on page 364.

Treatment, after removal of the causative agent, consists of fractional exposures of x-rays given weekly, together with antipruritic medications. In the chronic forms sedative remedies may be displaced by ones containing tar or salicylic acid. The technic of exposure has been described on page 369. Generally, three or four weekly treatments of $\frac{1}{4}$ E. D. relieve the pruritus and cause involution of the lesions, but occasionally the disease is persistently recurrent and requires similar dosage over a protracted time. In such an event, it is advisable to discontinue x-ray treatment after a sum total of 3 E. D. has been given. A skin erythema is liable to be followed by atrophy or telangiectasia of the labia or inner thighs, which may lead to serious sequelae.

When the lesions are small and discrete they are sometimes handled better by radium in direct contact, in a flat glazed salt applicator or a tube. These preparations should be unscreened unless the patches are thickened or crusted. A half-strength flat applicator may be used for fifteen to thirty minutes, unscreened or screened with 0.2 mm. of aluminum at intervals of ten days. A radium tube is employed only when the eczema extends into the folds of the fourchette or perineum. In these locations the tube is occasionally more adaptable than a plaque. According to the type of lesion, it may be unscreened in doses of 200 to 300 millicurie minutes or screened with 0.5 mm. of silver in a dose of 30 to 40 millicurie hours.

Eczema occurs in the gluteal crease and about the *anus*,[1] often secondary to pruritus ani or local involvement by ringworm, seborrheic dermatitis, or generalized eczema. The most common location is in the crevices between the rugae at the mucocutaneous junction. There it is subject to the treatment of pruritus ani (see page 365), namely, the relief of focal infections, intestinal putrefaction, fermentation, or constipation, the substitution of moist cotton for toilet paper and of olive oil cleansing solution instead of soap and water. Dietary measures are also of value. Antipruritic and sedative lotions and ointments should be used for the relief of the itching, and to overcome the lichenification, which is usually present.

In the majority of cases irradiation is curative. Roentgen rays are extensively used for this affection, and the results from them are excellent. Ultraviolet therapy occasionally has cured cases which have not responded to the roentgen rays, although, in general, the latter cause the itching and lichenification to disappear more readily. In a few cases radium treatment is indicated.

The technic for x-ray treatment of the anal region has been described on page 369. Often the results of the radiation applied are good or poor according to the care and skill with which the operator adjusts the position of the patient and the tube. As the anus is located 2 or 3 inches internal to the surface of the buttocks, to expose it so that the maximum dose will be applied to the affected area and not to the skin over the ischial tuberosities must be the endeavor of the technician. Individual variations in the anatomy of these parts make it necessary for him to try the patient in two or three positions before deciding which is the best. (1) The patient may lie on his abdomen, the buttocks being held apart by the hands or by strips of zinc oxide adhesive plaster attached distally to the sides of the table. (2) He may lie on the back with the thighs flexed upon the abdomen, the knees being flexed and held outward as well as upward. Although this position is uncomfortable, it is often desirable. (3) The knee-chest position may be assumed, the buttocks being separated by the patient's hands or zinc adhesive plaster, as described above.

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[1] See also chapter on Pruritus.

Proper shielding of unaffected parts—especially the hands and testicles—is imperative and is given by a metal cone or sheet-lead. A long anode-skin distance distributes the dose over a larger region and with minimum loss of intensity due to the concavity of the gluteal furrow. The distance, of course, should always be measured from the part of the body nearest the tube. When the affected area is extensive it is sometimes desirable to make two exposures. The direct line of focus of each exposure should be perpendicular to the other—one focused on the posterior anal commissure and the other on the anterior part of the perineum. These exposures are allowed to overlap.

Equally satisfactory results are obtained by unfiltered and filtered radiation. The dosage should always be suberythema and either fractional or semi-intensive. A $\frac{1}{4}$ E. D. may be given weekly in a series of eight such treatments, the number generally necessary for permanent results. When such dosage is continued for an entire series without improvement the treatment should be stopped as there is little likelihood of benefit and some danger of tissue injury from unlimited radiation.

The carbon arc and quartz mercury vapor lamps have a limited field of usefulness in the treatment of eczema of the anus, but in certain instances the result of ultraviolet radiation from these sources is surprisingly good. In the average case roentgen therapy should be used in preference to ultraviolet light, but in cases which do not respond to reasonable amounts of *x*-rays, actinotherapy should be instituted. Before treatment the crusts should be removed by olive oil and the affected area should be exposed to the best advantage by means which have already been described. By special quartz applicators used in conjunction with the Kromayer lamp the rays may be directed to the affected area. Full erythema doses should be given as they are necessary to control the pruritus. Generally, exposures are repeated at intervals of five or seven days for a period of two to three months.

Radium therapy is indicated only where the lesions are localized to small patches. Half-strength flat glazed applicators, unscreened or screened with 0.1 mm. of aluminum, should be employed, and exposures of three to five minutes' duration given on each of three successive days. The series may be repeated at intervals of three or four weeks. When there is a small persistent fissure a glass tube containing radium may be applied unfiltered in a dose of 150 to 200 millicurie minutes. Such treatment will often cure this type of fissure permanently. More extensive areas which are not thickened are often cured by a single intensive treatment with the *w*-rays.

In conjunction with irradiation the following formulas may be advantageously prescribed for eczema about the anus:

℞.	Phenolis	gr. x
	Camphorae	gr. v
	Liq. alumini acetatis	ʒiij
	Adipis lanae	q.s. ad. ℥j

M. and S. Apply locally often enough to allay itching.

℞.	Sulphur praecip	gr. xv
	Liq. carbonis detergent.,	
	Mentholis	āā gr. x
	Acidi salicylici	gr. x
	Boroglycerini	ʒj
	Adipis lanae hydrosi	q.s. ad. ℥j

M. and S. Affected area three or four times daily.

℞.	Calaminae praep.,	
	Zinci oxidi	āā ℥ss
	Phenolis	ʒss
	Mentholis	gr. v
	Glycerini	℥j
	Aquae calcis	℥iv

M. and S. Soak upon pledget of cotton and place within gluteal crease three or four times daily.

DERMATITIS SEBORRHOEICA

Synonyms.—Seborrheic eczema, seborrhoea corporis.

The term "pityriasis" is applied to a variety of conditions which are in common characterized by delicate branny scales and the absence of any apparent sign of inflammation. Such scaly patches have a predilection for the scalp, supra-orbital regions, cheeks, lobes of the ears, and flexor surfaces. There are several clinical varieties, some of which may become more or less inflamed, have coarser greasy scales, or be eczematized from scratching. These lesions have been grouped by Unna under the heading of seborrheic eczema, while other writers employ the term "seborrheic dermatitis." The disease is undoubtedly infectious and is distinct from eczema both as regards etiology, course, and treatment.

The etiology of seborrheic dermatitis is undetermined, and probably some of its various expressions are due to different causes. The Pityrosporon of Malassez and numerous staphylococci are usually present in the scales, and the experiments of MacLeod and Dowling appear to prove that the disease is a pure fungus infection with the Pityrosporon. Like other related fungi, the Pityrosporon grows best in subjects with moist, greasy skins, and in locations in them which are specially moist and warm, such as the axillae, interdigital folds, scalp, presternal, and interscapular regions. The growth is also favored by conditions which tend to increase perspiration and sebaceous activity. Benedek found a minute organism, the Schizosaccharomycetes, in the scales and on hairs pulled out and in some instances in the circulating blood. This organism has been present in practically all cases examined. He assigns etiologic importance to the same organism in other diseases—acne vulgaris, rosacea, and sycosis vulgaris.

For the sake of clarity the different expressions of this clinical entity will be considered topographically.

Scalp.—On the scalp the least severe phase—pityriasis sicca—manifests itself as a dry branny desquamation, beginning in small patches and rapidly involving the entire surface, with a profuse amount of fine powdery scales. There is often a history of sudden onset, and it is apparently infectious, coming on after visits to hairdressing establishments, especially following permanent waves. An oily type of dandruff, at times accompanied by erythema and an accumulation of thick crusts, is also encountered. There is a tendency for the hair in the affected areas to fall out, characteristically beginning on the vertex and frontal regions and progressively receding. It is commonly associated with premature baldness in men, is auto-inoculable and probably infectious. Other types of seborrheic dermatitis on the scalp are more severe and are manifested by greasy, scaling configurate patches or psoriasiform eruptions.

An excellent method for the treatment of the scalp is to prescribe a lotion for daily use and an oil or pomade for use once weekly the night before a shampoo. The pomade should be antiseptic and keratolytic in all types of dandruff and, in addition, stimulating in pityriasis sicca. As a rule the scalp should be washed once a week, but if the hair is excessively oily the shampoo may be given twice a week or daily for a short time.

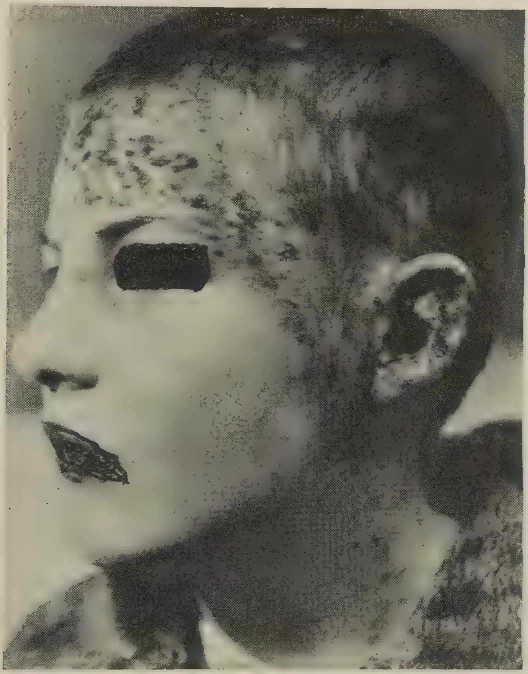

Fig. 244.—Seborrheic dermatitis. Typical involvement of the scalp, forehead, and ears. (Courtesy of Dr. Samuel T. Millard.)

The following drugs are commonly incorporated in scalp lotions and pomades. Considerable caution must be exercised to obtain good pharmaceutical preparations which will effect the desired clinical results. Resorcin or betanaphthol should not be used on blonde or white hair, and mercury and sulphur should only be combined in the same prescription if the red or yellow oxides of mercury are used. Bichloride of mercury may be substituted for zinc sulphocarbolate in the lotion given for blonde, gray or white hair. Sulphur and ammoniated mercury are effective antiseptics but are difficult to wash out of long thick hair. A moderate amount of alcohol in scalp lotions is definitely antiseptic and there is no objection to its use. Any drying action from it may be avoided by the addition of oil to the lotion, castor oil being usually incorporated in small amounts in lotions to be used by men. Oils in scalp lotions for women are to be avoided because they tend to make the hair stringy. When oils are used for women they are best applied only immediately before shampooing but, if necessary, may be frequently used in the form of brilliantines. Whenever the oiliness is excessive, salicylic acid, 1 drachm; liquor carbonis detergens, ½ ounce; spiritus vini rectificati, 2 ounces, may well be substituted for the ointments, and occasionally solvents such as acetone or carbon tetrachloride are useful.

Remedies of frequent benefit are euresol, quinine hydrochloride, zinc sozoiodolate, thymol, the oleate and salicylate of mercury, oils of cedar, birch or cade, benzoic acid, salicylic acid, chloroform, carbon tetrachloride, carbon disulphide, and formalin. Effective prescriptions for the treatment of the scalp with sulphur are as follows:

℞.	Zinci sulphocarbolatis	ʒj–ʒij
	Resorcinolis	ʒj–ʒiv
	Betanaphtholis	ʒss
	Spt. vini rect	℥iv
	Aquae destillat	q.s. ad. ℥viij
	Oil of violet or oil of bay	gtt. iv.
	Persionis (Cudbear) gr. ½ or Bismarck brown gr. ⅙.	

M. and S. For dark hair only. Apply above lotion. Violet color and odor for women. Bay odor and brown color for men. Ol. ricini ʒj to ʒiij may be added.

℞.	Formalin (liq. formaldehydi, 40 per cent)	ʒj–ʒiiss
	Acid. sulphurosi	℥ss
	Spt. vini rect	ʒii–ʒiv
	Aceton	ʒss–℥ij
	Aquae destillat	q.s. ad. ℥viij
	Ol. rosae geranii	gtt. xii

M. and S. Very drying antiseptic lotion for excessively oily scalps and coarse hair.

℞.	Zinci sozoiodolatis	ʒj–ʒij
	Oleoresinae capsici	ʒj–ʒiv
	Chloral. hydrat	ʒij
	Spt. vini rect	℥iv
	Aquae destillat	q.s. ad. ℥viij
	Ol. violae or ol. neroli	gtt. iv

M. Filter through cotton. Sig. Apply to scalp daily with cotton (or dropper or toothbrush) and massage in as directed for three minutes. Colorless for use on blonde, gray or white hair.

Mercury may be substituted in similar prescriptions:

℞.	Hydrargyri chloridi corrosiv	gr. ij–gr. iv
	Resorcinolis	ʒj–ʒiv
	Spt. acid. formic	℥ss
	Spt. vini rect	℥ij
	Aquae destillat	q.s. ad. ℥viij

M. and S. Apply to scalp daily with dropper and massage in as directed. For use only when hair is dark.

The following formulas are suggested for pomades:

℞.	Sulphur praecip	ʒj–ʒij
	Ol. rusci	gtt. x–xxx
	Acid. salicylic	gr. xv–xxx
	Ol. olivae,	
	Adipis lanae	āā ʒj
	Petrolati albi	

M. and S. Rub into scalp night before shampooing.

℞.	Hydrargyri ammoniati	ʒj–ʒiv
	Goose grease	ʒv
	Olei theobromatis,	
	Adipis lanae	āā ʒj
	Cerae albae	℥ss
	Petrolati albi	q.s. ad. ℥j

M. and S. Rub into scalp night before shampooing.

℞.	Hydrargyri oleatis	ʒj–ʒiij
	Oleoresin. capsici	gtt. v–ʒj
	Mentholis	gr. v
	Ol. pini pumilionis	gtt. x
	Ol. amygdalae amarae	gtt. iv
	Petrolat. liq. (light)	q.s. ad. ℥ij

M. and S. Rub into scalp night before shampooing.

For excessive oiliness lotio alba or colloidal sulphur should be rubbed in at bedtime once weekly or oftener and rinsed out the following morning.

Brilliantines according to the following formulas are suitable for women who have excessive dryness of the scalp and hair.

℞.	Ol. ricini	ʒv
	Persionis (Cudbear)	gr. 1/6
	Ol. violae	gtt. x
	Spt. vini rect.	q.s. ad. ℥ij

M. and S. Apply sparingly on hair brush with upward motion away from the scalp.

℞.	Ol. ricini,	
	Goose grease	āā ʒss
	Ol. theobromatis	ʒij
	Cerae albae	ʒj
	Adipis lanae	ʒiv
	Ol. roseae geranii	gtt. vj
	Petrolati albi	q.s. ad. ℥ij

M. and S. Solid brilliantine.

For fine hair, shampoo soaps should not be caustic. Sodium borate or potassium carbonate may be added to soaps used for oily scalps, especially in localities where the water is hard. A combination of cocoanut oil, palm oil, and soda forms the basis of many good shampoo soaps. The following formulas are given:

℞.	Ol. olivae,	
	Ol. theobromatis	āā 25 per cent
	Potassii carbonatis	1 per cent
	Liq. potassii hydroxidi	10 per cent
	Ol. bergamottae	ʒss to gal.
	Small amounts water	q.s.

Over a moderate water bath add potassium hydroxide slowly to other ingredients until all is added, then add water slowly to allow for evaporation until saponification is complete.

℞.	Saponis pulv	℥iv
	Potassii carbonatis	ʒij
	Ol. bergamottae,	
	Ol. lavendulae,	
	Ol. limonis	āā gtt. x

Mix well, allow to dry out and strain through cheesecloth.

℞.	Curd soap	℥viij
	Ol. amygd. express	℥ij
	Glycerini	℥j
	Cetacei	℥ss
	Potassii carbonatis	ʒij
	Aquae destillat	Oj
	Liq. potassii hydroxidi (10 per cent)	q.s.

Dissolve the potassium hydroxide in water and slowly add to other ingredients placed on a water bath of moderate temperature. Add water to allow for evaporation until saponification is complete.

℞.	Olive oil soft soap	90 per cent
	Potassii carbonatis	5 "
	Mentholis	¼ "
	Thymolis	¼ "
	Eucalyptolis	2 "
	Fldext. quillajae	2½ "

M. and S. Shampoo cream.

℞.	Tinct. saponis viridis	90 per cent
	Potassii carbonatis	2 "
	Picis liquidae	8 "

M. and S. Liquid tar shampoo.

The benefits from ultraviolet therapy on seborrheic dermatitis of the scalp are widely recognized. The local action is bactericidal and stimulative. A few applications are sufficient to cure mild cases, and persistent treatment in severe cases invariably is successful in controlling the progress of the disease. Exposures may be given in conjunction with local medicinal therapy. Cure is attested by the disappearance of subjective discomforts—itching, tickling, burning, *et cetera*—and the cessation of dandruff and the regrowth of the lost hair. The scalp should be washed the day before the application. Mild erythema exposures to the top and sides of the scalp are given at intervals of five to seven days. In recalcitrant cases a third degree erythema to each portion of the scalp may be necessary. The application is repeated when the reaction from the previous one has subsided. Russell avers that if three to four treatments are given every six months the scalp will be kept in a normal condition.

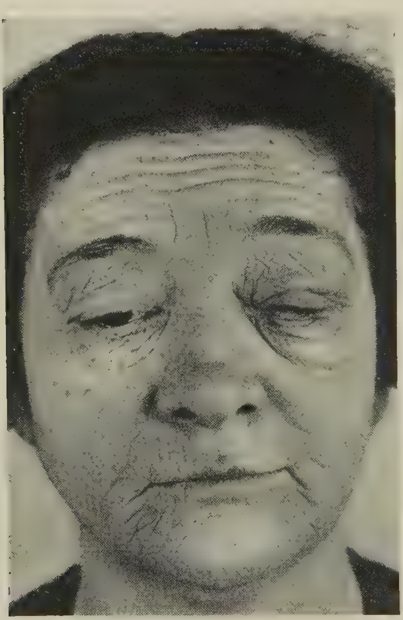

Fig. 245.—Seborrheic dermatitis with characteristic involvement of the eyelids and about the mouth.

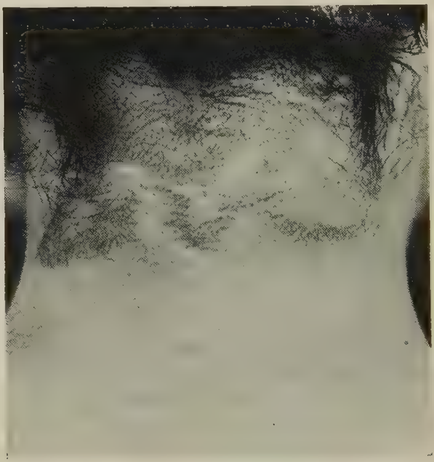

Fig. 246.—Configurate type of seborrheic dermatitis of the back of the neck. (Courtesy of Dr. Frank Vero.)

Actinotherapy is useful in both the dry and oily phases of this disease. The air-cooled mercury vapor or carbon arc lamps are equally beneficial, as is also distance irradiation with the Kromayer lamp, with which exposures of one to five minutes' duration from a distance of 2½ inches are given twice weekly, and continued for several months.

When the crusting is thick, the cure is hastened by the use of unfiltered x-rays instead of ultraviolet light. One-quarter E. D. is applied to five areas as in the manner described for the treatment of ringworm of the scalp. This dose may be repeated but a total of no more than $\frac{1}{2}$ E. D. should be given to any of the five areas, as larger amounts entail the danger of epilation. The series of two treatments may be safely repeated after an interval of two months.

Face and Neck.—The forehead is commonly involved and scaly patches, which are sometimes greasy, occur on the cheeks and ears. The eyebrows and edges of the lids, the nasolabial angle, and buccal commissures are favorite sites. On the neck the lesions are often configurate and pinkish yellow, or thickened, pruritic and eczematized, the latter form occurring at the occipital hair line.

Trunk and Extremities.—The affection has a predilection for the sternal and interscapular areas, the axillae, groins, navel, and gluteal crease. In these areas macular yellowish patches with more or less greasy scaling are characteristic, but less frequently the lesions are circinate patches or follicular papules. The lesions may be widely distributed or generalized, with erythema, scaling, oozing, and more or less pruritus. Secondary infections causing furunculosis frequently ensue. On the extremities the antecubital and popliteal regions often become lichenified from scratching and the friction of clothing. The hands, feet, and even the nails are occasionally involved.

Seborrheic dermatitis of the glabrous skin is usually cured by proper local remedies, of which those containing sulphur are the most beneficial. Precipitated sulphur is applied in an ointment or in the form of lotio alba, to either of which 3 per cent resorcin may be added. As these may be irritating it is necessary to use them with caution.

℞.	Sulphur praecip	gr. x–ʒss
	Adipis lanae,	
	Petrolati albi	āā q.s. ad. ℥j

℞.	Resorcin	ʒj
	Lotionis albae	℥iv

℞.	Acid. salicylic.,	
	Sulphur praecip	āā gr. xv
	Ol. rusci	gtt. x
	Ol. theobromatis	ʒj
	Adipis lanae hydrosi	q.s. ad. ℥j

In generalized cases soothing baths and the general hygienic measures described for eczema are indicated. At times thyroid extract is a valuable remedy.

In the acute cases daily generalized air-cooled ultraviolet treatment is efficacious. Although the results from the applications are not immediate or spectacular, it undoubtedly provokes a gradual and steady improvement. The exposures should be suberythema or produce a first degree reaction. Benefit often seems proportionate to the pigmentation induced by the light.

The effects of roentgen-ray therapy are uniformly excellent, rapid response following small exposures. Fractional treatment is beneficial in oily seborrhea of the face, the technic being similar to that described for acne vulgaris. Caution must be observed to avoid excessive dryness or wrinkling. The macular and papular scaly eruptions which occur on the trunk, and the more or less generalized pruritic, exudative, and psoriasiform manifestations are best treated by a combination of ointments and irradiation. *x*-Rays are of outstanding value in the treatment of lichenified areas in the flexures and on the back of the neck running up into the scalp. When there is much thickening, filtration is recommended. The technic for the treatment of the hairy parts has been described on page 404.

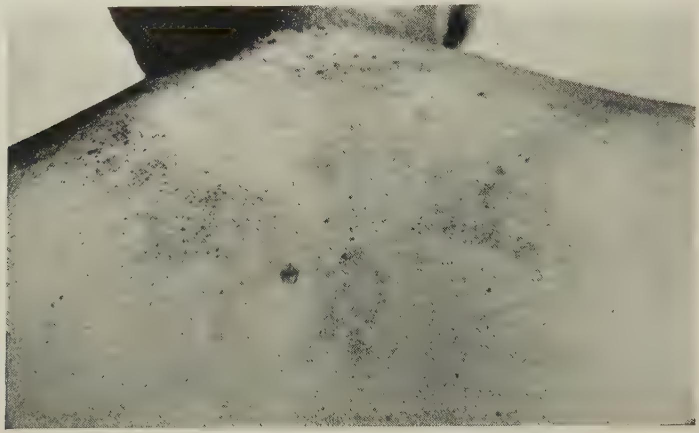

Fig. 247.—Circinate lesions in seborrheic dermatitis of the upper back.

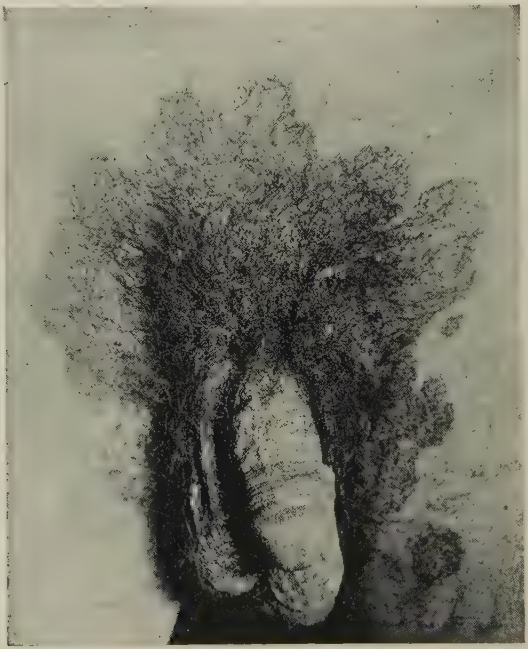

Fig. 248.—Configurate type of seborrheic dermatitis of the pubic region.

INFANTILE ECZEMA

Synonym.—Milk crust.

Infantile eczema occurs principally during the first two years of life. Two varieties are distinguished—seborrheic eczema and true infantile eczema. The former occurs infrequently, affecting the scalp and flexures of the elbows and knees. The lesions are well-defined, more or less circinate erythematous patches covered with greasy yellow scales. As pointed out by MacCormac, perhaps the most definite evidence of the nature of seborrheic eczema is its rapid response to treatment with weak sulphur or mercury ointments.

The second variety, which is the more common and characteristic, is occasionally distinguished from the former by the term "true infantile eczema." This disease—like eczema in general—begins with poorly defined erythematous itching areas, which soon become vesicular and thickly crusted. Secondary infection by pyogenic cocci is the rule rather than the exception. In the course of time the skin becomes thickened and scaly. In the same case the exudative stage may alternate with the dry scaling stage, exacerbations occurring whenever the exciting cause is particularly active. The pyogenic infection, due to scratching, leads to lymphadenopathy and abscesses. The lesions begin on the cheeks and forehead, from which they spread to the ears, scalp, arms, legs, and trunk. Whereas eczema usually occurs among well-nourished children, the general health often becomes undermined in protracted cases owing to nervous irritability, which interferes with nutrition and sleep. Infants with eczema are susceptible to attacks of diarrhea, bronchitis, and asthma.

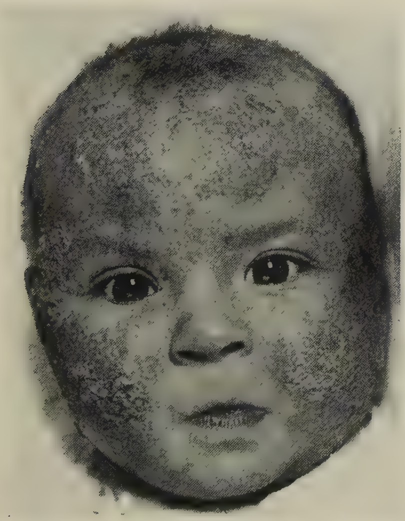

Fig. 249.—Infantile eczema. Note that the skin about the mouth is free from involvement. (Courtesy of Dr. Charles W. McNitt.)

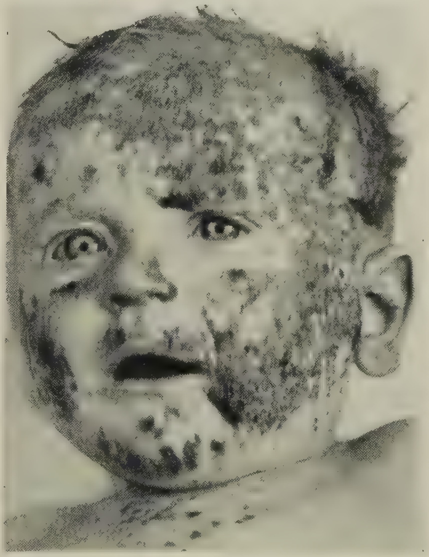

Fig. 250.—Infantile eczema. Typical distribution on face.

In the management of cases the consideration of certain predisposing causes is important. Infantile skin is of course very delicate, but xerotic or ichthyotic defects augment its sensitiveness. Any external irritation may precipitate an attack of eczema—sudden changes of temperature, harsh wind, strong soaps, vigorous rubbing, chafing, unduly heavy, tight or soiled clothing, insufficient cleanliness, especially in the diaper region, local infections, irritating secretions or chemicals. Often patients are predisposed to infantile eczema and attacks are aggravated by internal factors such as overfeeding, excessive fat or farinaceous food in the diet, defective digestion, constipation, and teething. Hypersensitiveness to food and epidermal proteins as proved by intradermal tests apparently accounts for the onset and persistence of the disease in certain individuals. A few infants are susceptible to products in the mother's diet, and possibly to plants ingested by the cows supplying the milk. Many are sensitive to egg white or cow's milk. Positive reactions of importance are not infrequently obtained to wheat, oat, wool, rabbit hair, chicken feathers, and horse hair.

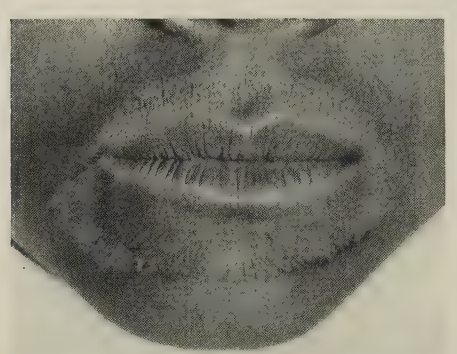
Fig. 251.—Eczema about the mouth in a child due to licking the lips. Such cases should be examined for Monilia.

Treatment.—One of the first considerations is the protection of the parts affected by eczema from the external irritants which have been listed as exciting causes, and from scratching. Local remedies are, as a rule, insufficient for this purpose and resort must be made to mechanical restraint. Among the methods often used are pasteboard splints applied over the elbows to prevent the infant from reaching the face. Rubbing against the pillow is effectively prevented by enveloping the head in a linen cap. Unless these precautions are observed a spell of scratching may counteract the results of days of treatment. Cleanliness is a matter of importance. As soap and water usually aggravate the affection, olive oil on absorbent cotton is used with gentle patting and avoidance of rubbing. Particular attention should be given the genitals and buttocks, and the diapers should be changed whenever they are soiled, fresh ones being applied after the parts have been cleansed with mineral oil and powdered with talcum. Digestive disturbance must be adjusted by appropriate remedies. Roi treated 14 cases by autohemotherapy with good results.

Various topical applications are employed for protection and relief of itching, which are the paramount considerations. At different stages of the disease these are varied to have a sedative action upon itching, to allay acute inflammation, to protect new skin which is forming, to avoid infection and to stimulate. Prior to the use of any local treatment it is necessary to remove the crusts and other inflammatory products from the diseased surface by the application of olive oil or a poultice of boric acid (ʒj) and starch paste (1 pint).

During the acute stage soothing creams are preferable. These may contain naftalan, carboneol, zinc oxide, and phenol. When the lesions are moist solution of aluminum acetate may be incorporated in the cream in proportions up to 25 per cent. Calamine and zinc lotion is a valuable application after the acute inflammation has subsided as it reduces the redness and relieves the itching. When secondary infection is prominent 2 per cent ammoniated mercury ointment is indicated. In the chronic stage stimulation is desirable and is best accomplished by the application of an ointment containing tar in the form of oil of cade, liquor carbonis detergens, or crude coal tar. In cases of severe thickening the addition of salicylic acid to the ointment is often of distinct benefit.

Generalized mercury vapor or carbon arc light treatments are so efficacious that they should be given in almost every case of infantile eczema. On the whole, their value for this condition is not sufficiently recognized. Ultraviolet therapy produces a gradual cessation of the pruritus and involution of the eruption, accompanied by an increase in the elasticity, pigmentation, and tone of the skin. Exposures should be given daily in small doses, below an erythema. Children with dark skins invariably do well but those of fair complexion sometimes react poorly. My experience has been that a little light is better than none in this latter group, but the dosage should be unusually small, *e. g.*, 1/10 E. D.

During the summer months sun baths may be substituted for artificial forms of actinotherapy. Exposures at high noon are made to the nude body in a situation sheltered from wind and dust. A white linen hat or an ice cap is worn to protect against sunstroke. The intensity and duration of the exposures should be carefully regulated and progressively increased in accordance with directions already given.

x-Ray treatment seems too hazardous to be recommended, although it has some advocates. When the eruption is recalcitrant to all other local remedies, subfractional unfiltered exposures may be justifiable, but they often give only temporary relief. Treatments should be repeated at infrequent intervals with careful protection of all vital structures. Relatively large surfaces are covered by a single exposure, and this fact, together with the tender age of the patient, demands a minimum dosage. Amounts varying between 1/16 and $\frac{1}{8}$ E. D. may be given weekly to the affected areas, including the scalp, but a total of no more than $\frac{1}{2}$ E. D. should be given to any area during one month. Costello has reported 5 cases of infantile eczema associated with asthma and enlarged thymus in which both conditions were cured by *x*-ray treatment of the thymus. Apparently the roentgen therapy had a direct effect on both the eczema and the asthmatic attacks, two exposures usually being sufficient.

INTERTRIGO

This form of eczema is caused by moisture, warmth, and friction in parts difficult to keep clean and where the skin is of a delicate texture. It is observed chiefly in the obese, in the flexures of the axillae and groins, in the anal region and beneath pendulous breasts. The affected area is erythematous and the epidermis overlying it is macerated. There may be erosions, fissures, and exudation, with subjective complaints of burning and itching. Microscopical examination is always advisable to exclude a parasitic cause.

Generally, intertrigo is cured in a few days by keeping the folds of skin separated so that they do not chafe and by applying dusting powders or drying lotions of calamine and zinc or tincture of benzoin. Salicylic acid is a favorite remedy and is incorporated in the powder or lotion, or used in the form of an ointment. Where the intertrigo is under pendulous breasts, the proper use of a brassiere frequently gives relief. When the gluteal crease is affected, the buttocks may be held apart by strapping with adhesive tape affixed to the sides of the hips and abdomen. Exposure of the intertriginous area to air and sunlight is beneficial. Dry heat applied from an ordinary incandescent bulb in a shoe box under a canopy or from a thermic lamp gives excellent results. Such heat may be applied by the patient two or three times daily in sessions of fifteen to twenty minutes.

When the affection is recalcitrant to these measures fractional doses of *x*-rays are extremely beneficial. Three or four exposures are sufficient in most cases to effect a permanent cure. The technic of irradiating the axillae, groins, and gluteal crease has been described in Chapter VI, pages 125 and 127.

Both carbon- and mercury-arc lamps may be used advantageously in the treatment of intertrigo. The exposures should be less than those required to produce an erythema and should be applied every few days and continued for two to three weeks until the itching has subsided and the skin has become normal. Russell reports similar benefits from this form of therapy.

NEURODERMATITIS

This term is applied to a disease variously known as lichen simplex chronicus (Vidal), névrodermite chronique circonscrite (Jacquet) and pruritus avec lichenification (Brocq), the principal objective symptom of which is lichenification. As a result of long-continued rubbing and scratching the skin occasionally becomes thickened and leathery, with a mosaic-like surface composed of flat shiny, more or less angular elevated planes, intervening between which are exaggerated furrows. This change known as lichenification may be primary, originating upon seemingly normal skin, or may be secondary, developing upon skin which is the site of another disease such as eczema, ringworm, and other affections. The condition may be circumscribed or diffuse. At times the eruption is decidedly papular, resembling lichen planus, and in other instances the patches are excoriated and slightly scaly or moist, and rarely they are nodular.

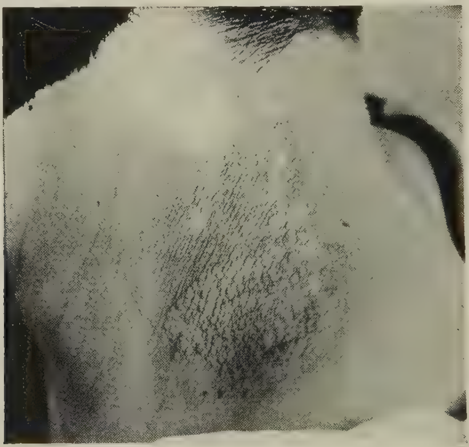

Fig. 252.—Neurodermatitis of the side of the neck. Note the crosshatching of the skin and other evidences of lichenification.

The disease has predilection for the back and sides of the neck, the antecubital, and popliteal areas. Neurodermatitis is ascribed to various causes such as nervous irritability, lack of emotional control, auto-intoxication, and chemical decomposition products, but habit formation plays an important, even major, rôle in long-standing cases.

The primary consideration is the control of the pruritus, which is accomplished by no other means so effectively as by irradiation. This type of therapy also has a decided action upon the lichenification, causing rapid involution. Generally a few fractional exposures bring about the desired result, the itching being frequently controlled by the first treatment. The dosage should always be below that which produces epilation or erythema. As a rule, unfiltered roentgen rays are employed but when the lesions are unusually thick the response is hastened by using filtration. On hairy parts radiotherapy must be particularly limited to avoid defluvium. It is usually safe in adults to give $\frac{1}{8}$ E. D. weekly to the scalp and eyebrows for four successive treatments, but after such a series there should be a rest interval of at least six weeks. Indirect roentgen therapy is occasionally beneficial and should be used in refractory cases which persistently recur in spite of local measures. The radiation is filtered, and focused over the spinal sensory ganglia. Schoenhof has reported five out of thirteen patients suffering from long-standing universal dermatitis materially benefited by this method.

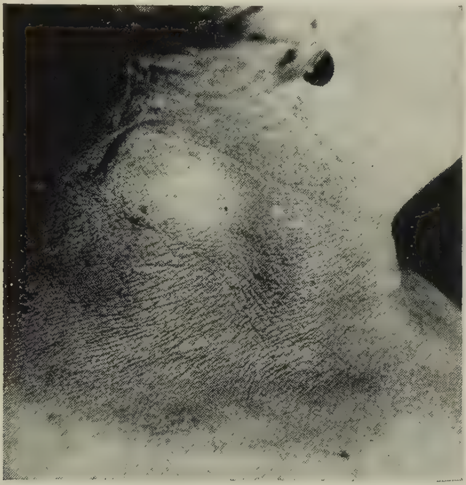

Fig. 253.—Pigmentation and lichenification in neurodermatitis on the side of the neck. (Courtesy of Dr. Maurice Belson.)

Good results are also derived from radium therapy, given in suberythema doses through a thin filter. The flat glazed half-strength applicator, screened with 0.1 to 0.2 mm. aluminum, is applied in contact with the lesion for an exposure of fifteen to twenty minutes' duration. The dose may be divided into three or four weekly exposures of five minutes each. When small patches are located on the scalp, eyelids or supra-orbital regions the same applicator unscreened may be held on the area for three or four minutes every other week.

The *w*-rays are beneficial in neurodermatitis but are less effective than the forms of irradiation previously mentioned.

The treatment of localized neurodermatitis by ultraviolet therapy is successful only when intense local reactions are produced, the diseased parts being irradiated from twenty to twenty-five minutes with the burner at a distance of 10 inches, and all the parts not affected being well protected. On the day following the treatment there are an intense redness and swelling of the irradiated area followed by desquamation of the epidermis. The manifestations of the reaction disappear in eight to ten days, at which time another treatment may be given. Frequently the itching is early replaced by slight pain due to the reaction. In the majority of cases, three or four exposures have been sufficient to cause more or less permanent disappearance of the disease. In the treatment of widespread neurodermatitis, especially in children, roentgen rays are hazardous and ultraviolet light is therefore the best remedy. Generalized exposures should be given daily in amounts sufficient to cause tanning. In addition, cod liver oil should be administered by mouth, and the skin should be freely covered with ointments containing tar and sulphur. Focal infections, nervousness, constipation, and other derangements in the general health should receive careful attention.

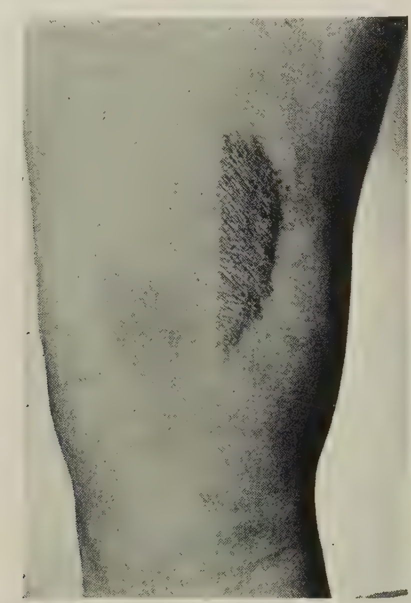

Fig. 254.—Linear patch of neurodermatitis of the thigh. (Courtesy of Dr. Frank C. Cross.)

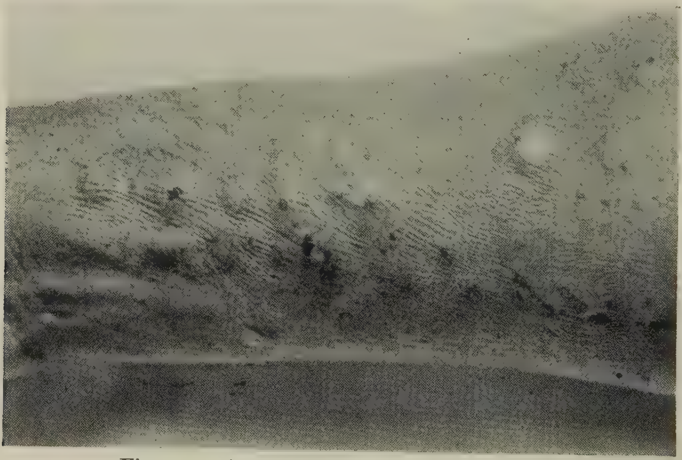

Fig. 255.—Nodular type of neurodermatitis.

Recurrences of neurodermatitis are frequent even after most careful treatment. Disseminated cases are rarely cured. To obtain the best results it is imperative to apply psychotherapy to control the habit of scratching and to resort to internal medicine in an investigation of the cause. For localized patches injections of benacol (see page 367) are valuable. During radiotherapy such antipruritic applications as the following are suggested:

℞.	Liq. carbonis detergent.	
	Phenolis	āā ʒss
	Glycerini	ʒij
	Mentholis	gr. x
	Spt. vini rect	ʒij
	Aquae camphorae	q.s. ad. ℥iv

M. and S. Antipruritic lotion for scalp.

℞.	Sulphur. praecip	gr. xv
	Phenolis	gr. x
	Liq. carbonis detergent	gtt. x
	Ac. boric	gr. x
	Ol. olivae	gtt. xv
	Adipis lanae hydrosi	q.s. ad. ℥j

M. and S. Ointment for glabrous skin.

It is important to recognize the fact that some cases of long-standing neurodermatitis or lichenified eczema have a definite intolerance for greasy preparations, especially those containing petrolatum. If this idiosyncrasy is kept in mind it is sometimes possible to obtain surprisingly good results from the sole use of oil of cade in amounts increasing from 1 to 30 per cent in an emulsion of olive oil, 10 per cent, tragacanth, and lime water.

INFECTIOUS ECZEMATOID DERMATITIS

This troublesome dermatitis is secondary to a discharging abscess, sinus or ulcer. Very often it is associated with furunculosis or chronic otitis media, bed sore, fistula or discharges from the eyes, nose, and vagina. Eczematous eruptions during the acute stages of second or third degree radiodermatitis and about chronic *x*-ray and radium ulcer belong in this category. The skin manifestations are probably the result of local sensitization to the bacterial or chemical irritants contained in the exudate. The affection spreads by peripheral extension and by auto-inoculation. The eruption may be vesicular, pustular or crusted, dry and scaly, or multiform. It is invariably pruritic and

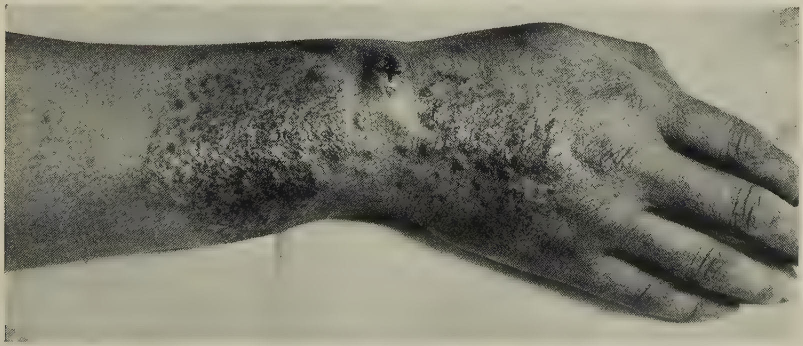

Fig. 256.—Infectious eczematoid dermatitis. Note original furuncle. (Courtesy of Dr. Elwood Weise.)

frequently accompanied by urticaria. Linear lesions are often present. The disease has a predilection for regions easily accessible to the patient's fingers.

Important considerations in the therapy of this recalcitrant dermatitis are the removal of the focus of infection and internal treatment. Alkalies by mouth, low protein diet, high colonic irrigations daily and saline cathartics are helpful in expediting the cure. Potassium permanganate, or Burow's solution baths, containing 1 pint of liquor alumini acetatis to one third of a tub of water, are helpful. Topical applications of calamine lotion, antipruritic dusting powders and wet dressings are used as indicated; pastes and ointments are contraindicated. Injections of autogenous vaccines or of foreign proteins are of value in most cases.

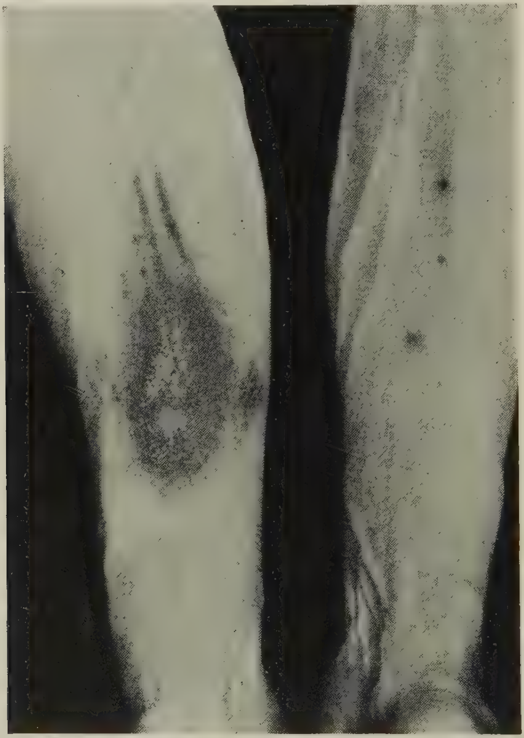

Fig. 257.—Infectious eczematoid dermatitis. Note occurrence in scratch marks.

Radiotherapy is useful in all stages of this dermatitis, but the benefits are not uniform and some cases fail completely to respond to either *x*-rays or ultraviolet rays. It is impossible to tell in advance which cases will or will not be helped by radiotherapy. In the acute stages it is not contraindicated but, on the other hand, often causes striking improvement and it never, in my experience, has been injurious. In the subacute and chronic stages, although radiation is frequently beneficial, it should always be supplementary to other forms of therapy.

x-Rays should not be used over a prolonged period if there is no definite response after a few treatments. When the lesions are localized, semi-intensive dosage with *x*-rays is permissible. When the eruption is widespread the dosage should be fractional or even subfractional. The technic for roentgenization in generalized eruptions has been described on page 119.

The results from ultraviolet therapy are often superior to those attained by x-rays. Perhaps the bactericidal action of ultraviolet light has a bearing upon its effects in this disease. It is most useful on widespread eruptions. Generalized exposures are especially valuable when there are pustules. They should be administered daily in slightly less than erythema doses.

PARASITIC ECZEMA

This term is little used at present, having been formerly applied to eczematous eruptions of suspected parasitic etiology. Due to the immense strides made recently in dermatomycology, the diseases previously comprehended in this group have been, to a large measure, further identified and assigned special terms such as dermatophytosis, moniliasis, and tinea cruris. This conception has also been expanded by the introduction of the expression eczematization and its application to skin changes superimposed upon the original parasitic affections by mechanical or chemical irritants or individual predisposition. The treatment of these dermatoses is described elsewhere under appropriate captions.

PITYRIASIS ROSEA

Synonyms.—Pityriasis maculata et circinata, herpes tonsurans maculosus, pityriasis rubra.

This dermatosis is a mild inflammatory disease of unknown origin, characterized by salmon-colored papular and macular lesions, which are at first discrete but later tend to become confluent. The individual patches are circinate and covered with finely crinkled dry epidermis. They are distributed in a more or less segmental arrangement on the trunk, upper arms, and thighs, with predilection for the axillae and groins. The disease usually begins with a single patch, spreads rapidly and, after an interval of three to ten weeks, tends to disappear spontaneously. The duration may be notably reduced by appropriate treatment. Some cases seem to be the result of dietary

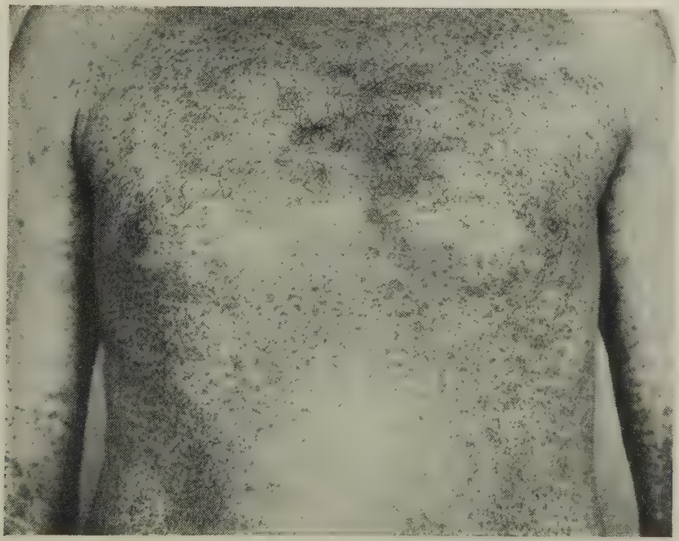

Fig. 258.—Pityriasis rosea. Follicular type. (Courtesy of Dr. Marie Karelitz.)

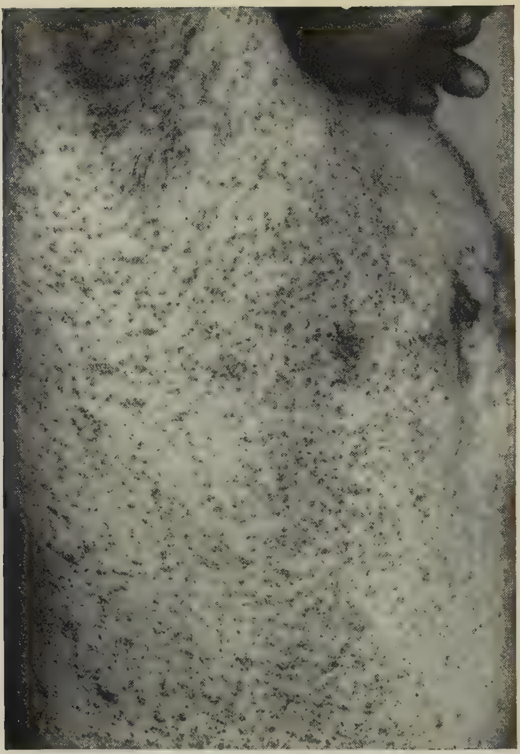

Fig. 259.—Papular type of pityriasis rosea.

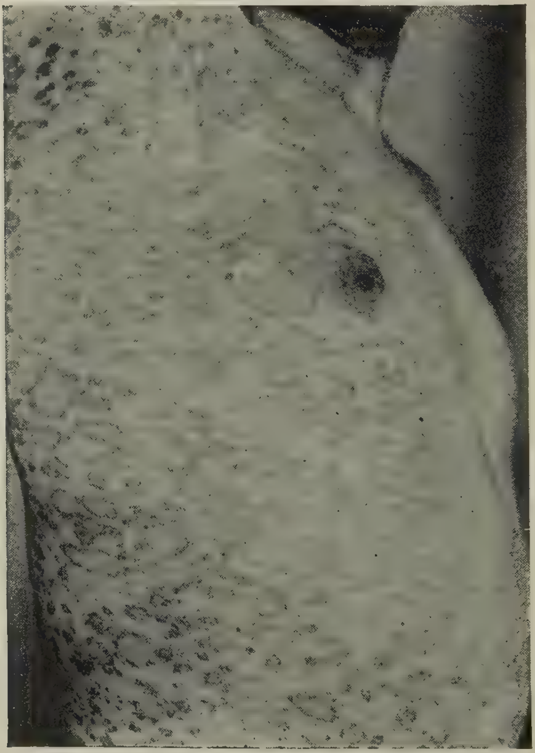

Fig. 260.—Macular type of pityriasis rosea.

indiscretions, and for this reason it is well to institute a simple diet, eliminating shellfish, cheese, hors d'oeuvre, canned foods, and excessive sweets.

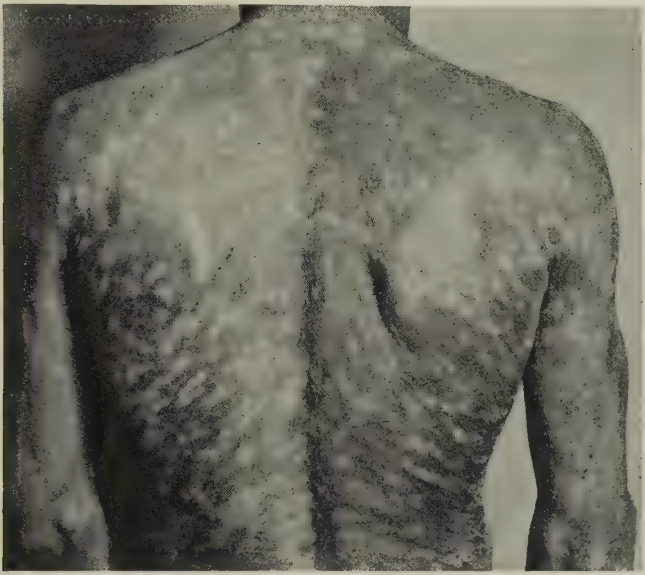

Fig. 261.—Pityriasis rosea in a negro. Note characteristic distribution of lesions with their long diameters parallel with the course of the ribs.

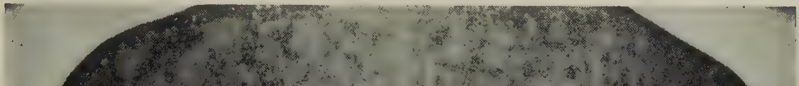

Fig. 262.—Extensive desquamation in pityriasis rosea, modifying the usual appearance of the eruption.

Weil and others think that it is from external, possibly parasitic, cause. As topical remedies are prone to irritate the skin of patients who have pityriasis rosea, only cold cream and talcum powder are recommended.

Pityriasis rosea must be differentiated from seborrheic dermatitis, tinea circinata, the macular syphilide, and psoriasis. Pityriasis rosea occurs on the trunk, upper arms, and thighs. It begins with a herald patch and spreads in a segmental manner, so that the oblong lesions are arranged along the ribs. The lesions consist of macules or maculopapules of old rose color and tend to clear in the center and leave a crinkled fawn-colored epidermis surrounded by an erythematous halo. The herald patch is often present for a week or so before the onset of the other spots, which come out rapidly. In seborrheic dermatitis the scalp and eybrows are usually scaly and there is a predilection for the sternal and interscapular regions, and the flexor surfaces of the articulations, where the patches are covered with greasy scales. The progress of seborrheic dermatitis is slow and often associated with itching. Tinea circinata is rarely so widespread and some of the lesions in such an extensive eruption present the typical vesiculation at the borders. The ringworm fungus may be demonstrated. In the macular syphilide the lesions are of a uniform size and soon assume a brownish tint. Scaling is absent or slight and there are generalized adenopathy, mucous membrane lesions, a positive Wassermann test and usually the remains of a chancre.

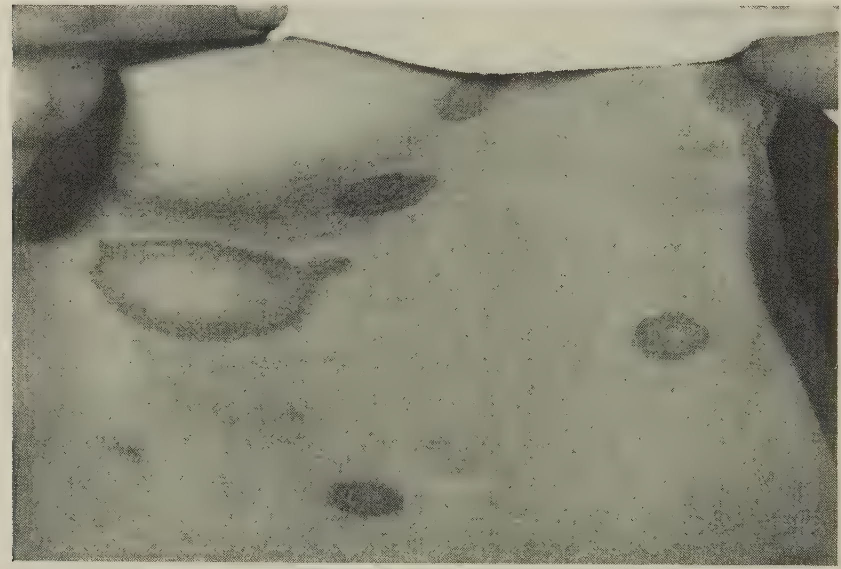

Fig. 263.—Pityriasis rosea with unusually large lesions.

Actinotherapy in erythema exposures should be used to expedite the involution of the lesions after the acute inflammatory stage has passed. The scaling patches and pigmented sequelae disappear following one or two generalized ultraviolet treatments. The erythema produced by the lamp is succeeded by superficial exfoliation. A few hours after the exposure the lesions blanch and the next day the scaly patches are easily rubbed off. In forty-eight hours the entire treated surface desquamates; the underlying skin is healthy and free from any signs of the disease, and in brunettes is likely to become pigmented. The whole process consumes about one week. Apparently the ultraviolet light acts only because of the exfoliation which it produces and has no specific effect upon the disease. The technic for generalized radiation is described on page 223. As pointed out by Michael, although the lesions may disappear after one treatment, usually a greater number is necessary. Residues following one treatment have also been noted by Halberstädter.

In severe cases the skin of the groins and axillae becomes intensely irritated. The patches in these areas tend to become confluent, causing extensive lesions, which are subject to the irritation of clothing. Itching is usually slight but in this type of case may grow intense and lead to eczematization and secondary infection from scratching. Unfiltered *x*-rays are specially efficacious as a means of relief of such irritations of the groins and axillae. They are also beneficial in eczematized forms of the disease in other areas, $\frac{1}{2}$ E. D. being recommended. Unfiltered *x*-rays likewise produce definite improvement in exposures of $\frac{1}{4}$ E. D. during the early stages of pityriasis rosea. I have frequently treated, in this manner, one half of the body without exposing the other half and found at the end of a week that the side irradiated was greatly improved.

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CHAPTER XVII

PSORIASIS

Synonyms.—Lepra, lepra alphos, psoriasis vulgaris.

Psoriasis is a common chronic inflammatory disease of the skin characterized by rounded circumscribed erythematous, dry scaling patches of various sizes. The lesions have a predilection for the scalp, ears, extensor surfaces of the limbs and the sacral region. The eruption may be exanthematic, with the sudden onset of numberless guttate lesions, or may consist of a few inveterate patches. The cause of the disease is unknown.

The early lesions are guttate erythematous macules or maculopapules, which from the beginning are covered with dry silvery scales. These lesions are best observed in the acute type of the disease. By peripheral extension and by coalescence, the spots increase in size, and through the accumulation of scales they become thicker. Nummular (coin-shaped) lesions are common. In this variety certain distinctive features may be easily demonstrated: (1) the scales are micaceous, and looser toward the periphery of the patch while adherent at the center; (2) upon removal of the scales, bleeding points occur. After the patches reach a diameter of about 5 cm., they cease spreading and tend to involute in the center, so that annular, lobulated, and gyrate figures are produced. Old patches may be thickened and tough, and covered with lamellae of scales so that they resemble the outside of an oyster shell (psoriasis ostracea). Various other descriptive terms are applied to the diverse appearances of the lesions: psoriasis guttata, in which the lesions are the size of drops; psoriasis follicularis, in which tiny scaly lesions are located at the orifices of the sweat and sebaceous glands; psoriasis figurata, psoriasis annulata, and psoriasis gyrata, in which curved linear patterns are produced by central involution; psoriasis discoidea, in which central involution does not occur and solid patches persist; psoriasis rupioides, in which crustaceous lesions occur resembling syphilitic rupia.

The course of psoriasis is inconstant. It usually begins on the scalp or on the extensor surfaces of the elbows, and may remain localized to the original region for an indefinite period, or completely disappear, recur, or spread to other parts. The beginning may be over the sacrum, where the patch slowly extends to form an inveterate lesion. At other times the onset is more sudden and widespread, as already described; or in other cases the first lesions may occur in unusual locations, even on the fingernails.

One of the chief features of psoriasis is its tendency to recurrences. These are commonly manifest over and over again throughout the life time of the patient. Rarely, however, psoriatics may remain completely free of the disease for years, and may be considered, in at least a practical sense, cured. Psoriasis has a tendency to occur on scars and in abrasions. On the scalp it does not cause a loss of hair. The lesions are sometimes easily irritated—even the chronic ones—and when this occurs they are liable to spread by the development of satellites, or new spots in other regions. In spreading eruptions if soothing remedies are not applied, a generalized exfoliative dermatitis may result.

Regional Types.—On the *scalp* the lesions are often nummular patches but at times there is a bandlike patch along the anterior hair line, or a palm-sized patch on the occiput which may be thickened and pruritic so that it alone might be mistaken for seborrheic dermatitis with lichenification. In other cases, profuse dandruff may accompany psoriasis of parts other than the scalp. Associated with the scalp involvement, there are often fissuring of the superior and the posterior auricular folds, and erythematous scaling patches about the external auditory meatus.

On the *face* chiefly guttate lesions are seen, especially in acute widespread eruptions, although some patients with a few scattered patches of long duration occasionally develop a few small spots on the face. Larger lesions, particularly the discoid variety, are rare in this location.

The *palms* and *soles* are rarely affected. Most cases so diagnosed eventually are proved to be due to syphilis, occupational irritants or eczema. Psoriasis does, however, at times affect these areas, forming diffuse erythematous, dry, scaling patches, or circumscribed verrucous thickenings, sometimes linear.

The *axillae, submammary folds, pubis, genitalia, groins,* and *gluteal crease* may be affected. Lesions in these locations, due to perspiration, maceration, and friction, become extensive erythematous, sodden, fissured patches that burn and itch.

Both the *fingernails* and *toenails* may be attacked. The characteristic changes are stippling, brownish discoloration, longitudinal grooving, leukonychia, cracking of the free edges, and heaped up crusts accumulated beneath them.

The various theories concerning the etiology of psoriasis are fully discussed by MacLeod, sentiment in this country seeming at present to favor a parasitic cause.

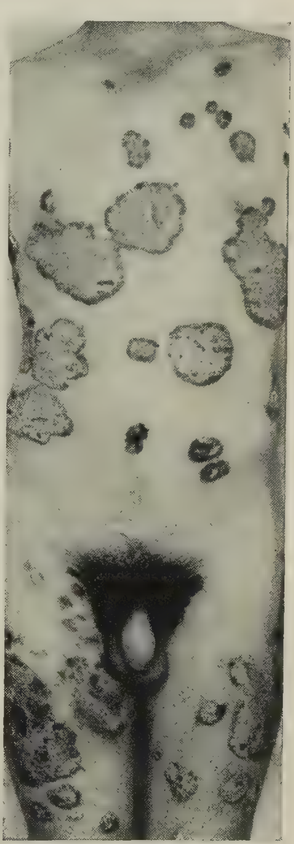
Fig. 264.—Psoriasis. Typical configurate lesions and common distribution.

Diagnosis.—Psoriasis must be differentiated from seborrheic dermatitis, pityriasis rosea, lichen planus, eczema, the psoriasiform syphilide, and lupus erythematosus. The distribution in psoriasis is on the extensor surfaces, especially of the elbows and knees, and on the scalp, whereas in seborrheic dermatitis, although the scalp is involved, there is a predilection for the eyebrows, nasolabial angle, the ears, the sternal region, and the flexures. The scales in psoriasis are dry, white, and shiny, whereas those in seborrheic dermatitis are greasy and lusterless. On removal of the scales in psoriasis there is an oozing of blood from the capillaries, whereas this does not occur in the seborrheic dermatitis. In pityriasis rosea the eruption is located on the upper arms, trunk, and thighs, and the duration is a matter of weeks. There are oval, fawn-colored patches which centrally show a crinkling of the epidermis and an almost imperceptible scaling. The onset with the herald patch and the tendency to arrangement of the subsequent lesions so that their long diameters are parallel with the direction of the ribs usually facilitate the distinction between pityriasis rosea and psoriasis. Lichen planus affects chiefly the flexor surfaces of the forearms and wrists, and the

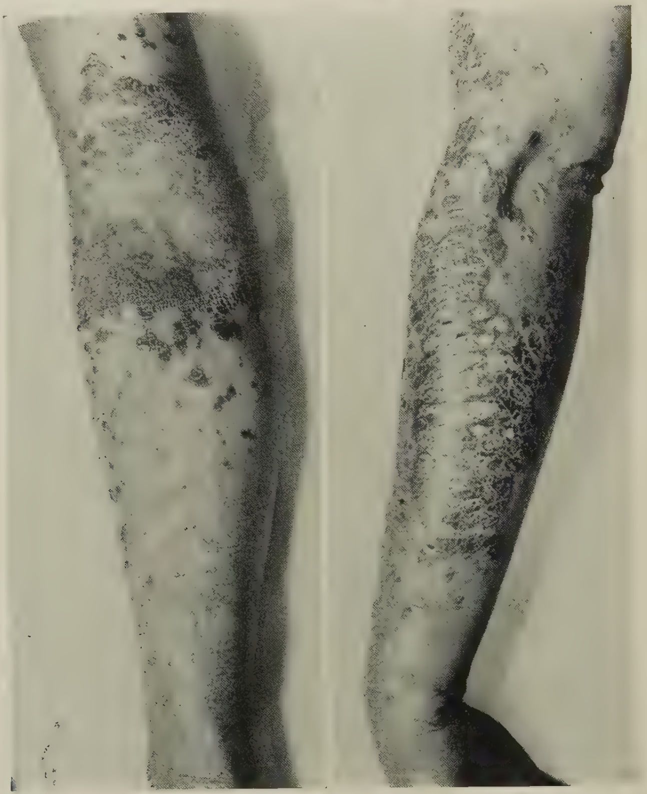

Fig. 265.—Typical patches of psoriasis on the dorsal surface of the elbows and forearms.

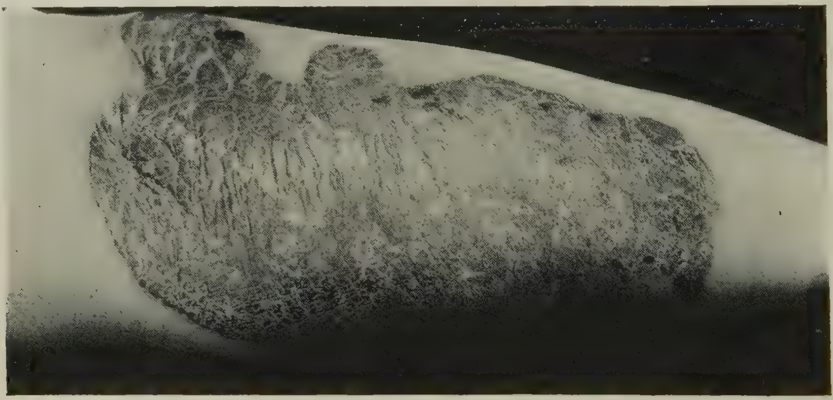

Fig. 266.—Extensive patch of psoriasis on the back of the elbow and forearm.

shins and ankles. The patches are pruritic and thickened. Often the violaceous color is pronounced but at other times the patches are a dirty brown color and are then only distinguished from psoriasis by close examination, which reveals that the scaling is not at all micaceous and that there are lichen papules at the edge of the patch. In eczema the distribution is usually not on the extensor surfaces of the elbows and knees and there are an exudation and a slight grayish scaling, accompanied by some itching. The psoriasiform

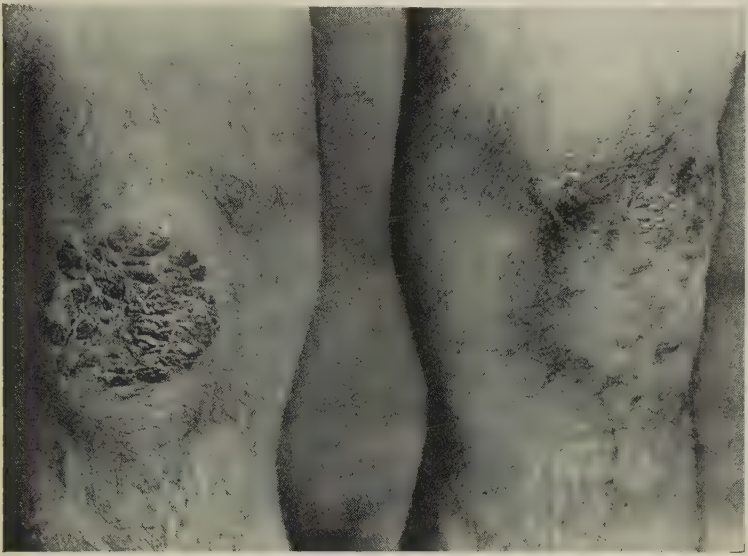

Fig. 267.—Psoriasis in a common location.

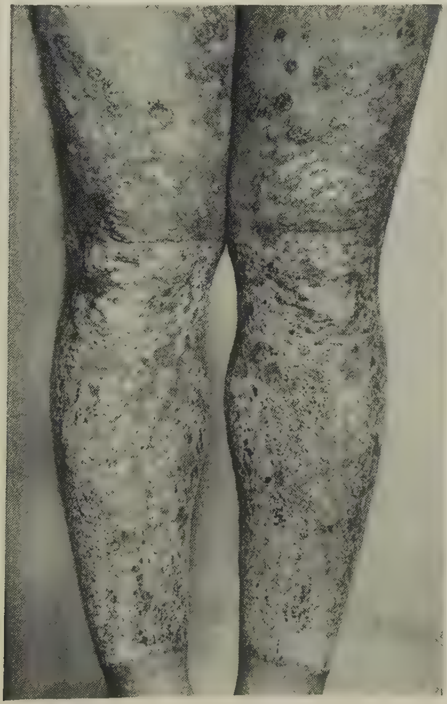

Fig. 268.—Psoriasis.

syphilide affects principally the palms and soles, where psoriasis is very rare. The lesions are infiltrated patches composed of dark-red or copper-colored papules which are often arranged in a configurate manner. The scales are brownish and sparse. The Wassermann test is positive; there are a general adenopathy, and often mucous patches, condylomas, and other symptoms of late secondary syphilis. In lupus erythematosus, the lesions are discrete plaques usually on the face and scalp, where there are atrophy, scaling, and alopecia. The face is not frequently affected by psoriasis. The scales of lupus erythematosus are grayish and adherent. Upon removal of the scale the under surface is seen to be papillose due to the projecting follicular plugs.

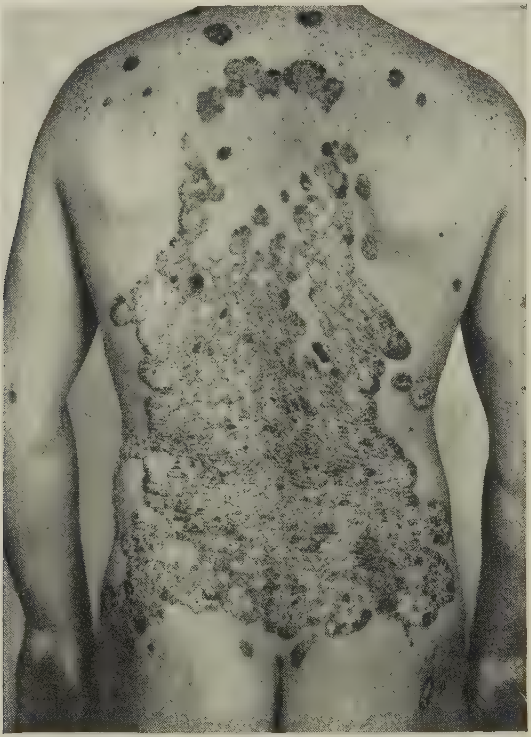

Fig. 269.—Extensive psoriasis of the lower back.

Treatment.—Treatment is palliative, the multiplicity of the remedies being mute evidence of their inefficiency. The lesions may disappear spontaneously or as the result of therapy, but recurrences are almost certain, and there is a tendency for the attacks to become progressively worse and for each remedy gradually to lose its effectiveness. In rare instances, however, the disease is apparently cured, showing no evidences for years.

In the *general management* of persons affected with psoriasis there are a few measures which are generally accepted as beneficial. If the scales of the lesions are removed by frequent hot baths with strong soap, the benefit of local applications is augmented. Derangements of the general health, particularly nervousness and rheumatism, should receive attention, and the diet should not include foodstuffs which are irritating to the skin, especially such as:

Shell foods.
Strawberries.
Fish, except white fish.
Pickles.
Cheese (except cream or pot cheese).

Red meats must be eliminated; but fowl and white fish may each be eaten twice a week.

Coffee and tea should be limited to 1 cup a day and both should be weak.

Alcohol must not be taken in any form whatsoever. Highly seasoned foods are to be avoided.

Alkaline mineral waters are very desirable. At least 2 quarts of fluid should be taken each day.

In acute spreading eruptions local applications should be soothing. Olive oil, calamine liniment, cold cream, toilet lanolin, soft zinc oxide paste, or 3 per cent ammoniated mercury ointment may be used. As the acute inflammation subsides, stronger applications may be tolerated; but one should always be cautious in order to avoid irritation. Ointments are usually more beneficial than lotions or paints. At this stage the ointments may contain 5 per cent ammoniated mercury, 2 per cent yellow oxide of mercury, or 3 per cent salicylic acid. For quiescent or chronic patches one may prescribe ointments composed of ammoniated mercury, 10 to 50 per cent; salicylic acid, 5 to 30 per cent; oil of cade, 5 to 50 per cent; chrysarobin, 1 to 10 per cent, or pyrogallic acid, 2 to 10 per cent. Inveterate patches may be painted with chrysarobin solution, 5 to 20 per cent in chloroform, or in traumaticin.

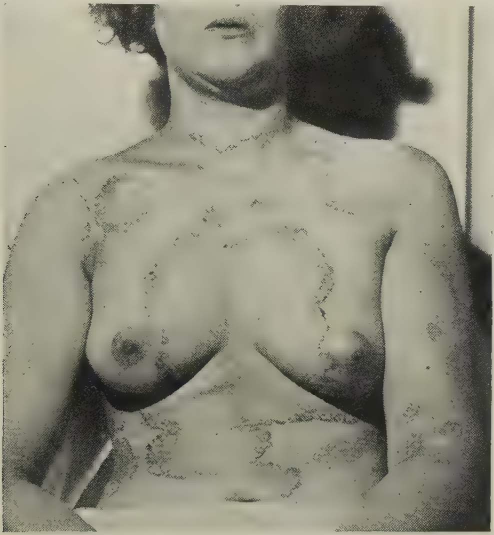

Fig. 270.—Psoriasis. Configurate lesions.

In addition to these remedies, the following prescriptions are recommended:

For acute eruptions—

℞.	Liq. alumini acetatis (Burowii)	℥ij
	Adipis lanae	℥iv
	Mentholis	gr. x

℞. Make up ung. aq. rosae (U. S. P.), only substitute 2 per cent solution of aluminum acetate for the water and leave out the perfume.

℞.	Liq. carbonis detergent	ʒij
	Sodii biboratis	ʒj
	Tinct. benzoini	℥j
	Alcohol, 50 per cent	q.s. ad. ℥viij

For inactive patches on the trunk and extremities—

℞.	Ac. salicylic	ʒij
	Ung. diachylon	℥iv

℞.	Ac. salicylic,	
	Ammoniated mercury	āā ʒj
	Adipis lanae	℥iv

For inactive patches on the scalp—

℞. Liq. carbonis detergent.
S. Paint locally morning and night.

℞.	Ac. salicylic	ʒss–ʒj
	Ac. benzoic	ʒj–ʒij
	Lanolin (toilet, Squibb)	℥j

℞.	Ac. salicylic,	
	Hydrarg. ammon	āā gr. xx
	Lanolin (toilet, Squibb)	℥j

For intertriginous lesions—

Fissures should be painted with 10 per cent solution of silver nitrate, after which pastes may be used. Phenol, 2 per cent, may be added to these if there is itching or pain.

℞.	Ac. salicylic	gr. xx
	Past. zinci oxidi (Lassar)	℥j

℞.	Hydrarg. ammon	ʒss
	Past. zinci oxidi (Lassar)	℥j

All ointments should be rubbed in thoroughly, preferably after bathing with hot water and strong soap, which removes the loose scales. A toothbrush, or a piece of flannel over the blunt end of a clothes-pin is useful for the inunction. On the scalp, ointments are applied chiefly at bedtime and are washed off the following morning with tar soap. Petrolatum and other vehicles which are difficult to saponify should be avoided. Generally hydrous wool fat, diluted with 3 to 5 per cent olive oil, is preferable as the basis for a pomade, or a mixture of 10 per cent each of cocoa butter and boroglyceride in hydrous wool fat. There is the danger of absorption from the liberal application of mercury, chrysarobin, and pyrogallol on extensive areas, and their use should therefore be limited, and guarded by weekly examination of the urine for evidences of renal irritation. Chrysarobin is in addition exceedingly irritating to the eyes, and patients who are using it should be warned to wash their hands and keep their fingers away from their eyes. As chrysarobin and pyrogallol also discolor the hair, they should not be used on the scalp or face.

On all other *areas under x-ray* or *radium treatment* moderation should be exercised in the use of local remedies. It is difficult to do more than generalize concerning those suitable in conjunction with radiotherapy, because the choice varies in accordance with the type of lesion, its location, the sensitiveness to drugs and other individual characteristics, as well as the kind and quantity of radiation. As a rule, the use of stimulating or irritating local remedies increases the effects of any kind of radiotherapy. This action is particularly pronounced with roentgen rays, in which connection it is important to realize that the strength of the local application and the size of the dose of *x*-rays have a reciprocal relation, *i. e.*, if the one is large, the other must be small. Where the *x*-ray dosage is fractional, it is often of advantage to use fairly strong ointments on patients whose toleration to ointments is known. Such combined treatment causes more rapid involution than would be obtained

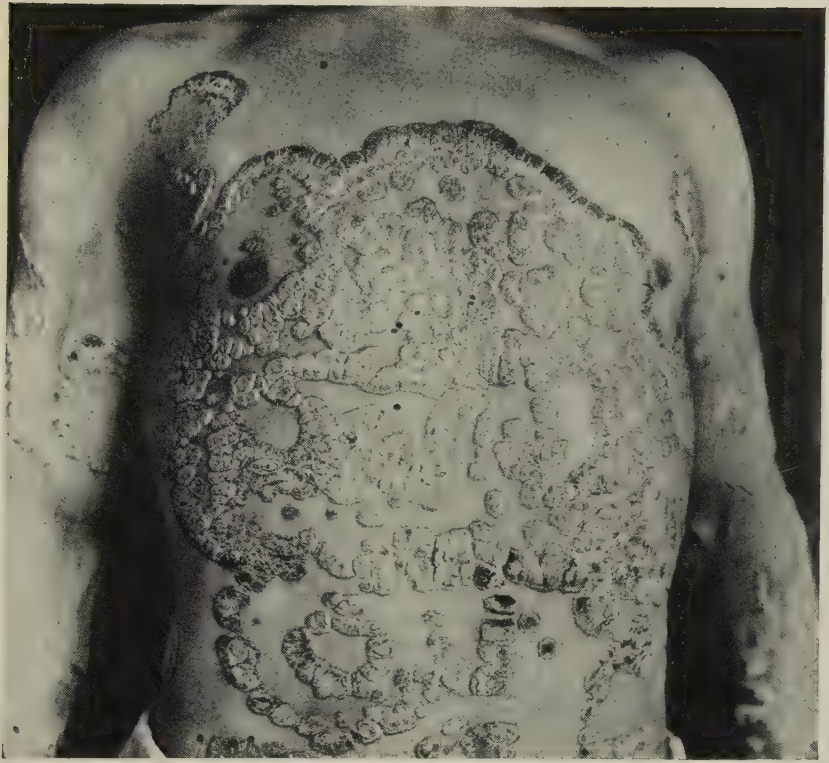

Fig. 271.—Configurate eruption of psoriasis composed of nummular lesions. (Courtesy of Dr. Mihran B. Parounagian.)

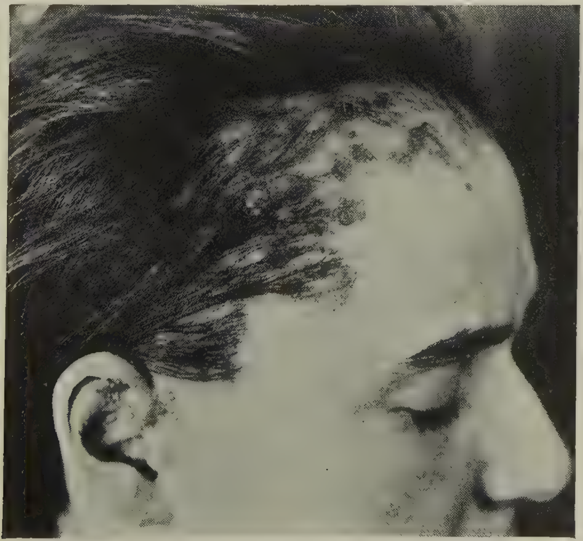

Fig. 272.—Psoriasis of the scalp, forehead, and ears. A common distribution.

by either method alone and minimizes the amount of x-rays necessary. The use of 5 per cent ammoniated mercury ointment during fractional roentgen-ray treatment is without danger. Stronger ointments should be used judiciously in recurrent cases, on the basis that the greater the benefit derived from ointments, the less the amount of radiation required. Where the lesions are thickly crusted, treatment with keratolytics preliminary to the irradiation and discontinued at its institution is better than treatment by irradiation alone. Subsequent to the use of strong keratolytics, the irradiation should be limited to fractional dosage. In all cases the best results from radiotherapy are obtained by its combination with other methods. At the beginning, weak strengths of the following ointments may be used: Ung. hydrarg. ammon., 5 to 10 per cent; Ung. hydrarg. oxidi flav., 1 to 2 per cent; Ung. ac. salicylic, 5 to 10 per cent; Ung. ol. cadini, 3 to 5 per cent; Ung. naftalan, 5 to 10 per cent. The toleration of the patient to each remedy should be carefully watched and used as a guide for increasing the strength of it. Ultraviolet therapy places no restrictions on the strength of the local remedies, which may be similar to those employed in the case of patients not under roentgen therapy. Goeckerman believes that crude coal tar applied for twenty-four hours before the exposure has a specific value in augmenting the action of ultraviolet light, apparently sensitizing the lesions to it.

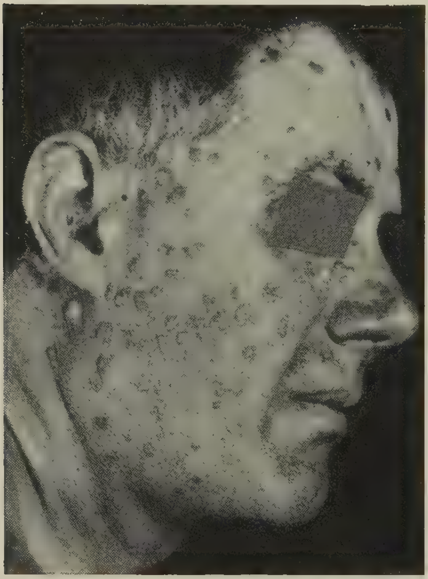

Fig. 273.—Psoriasis of the face. The scaling, papular lesions resemble those of secondary syphilis. (Courtesy of Dr. Mihran B. Parounagian.)

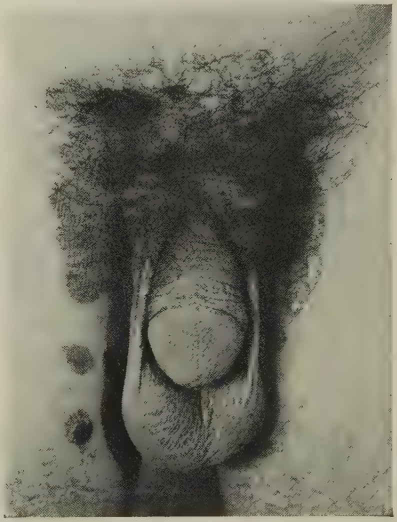

Fig. 274.—Psoriasis of the pubic region.

x-Rays.—The use of roentgen rays in the treatment of chronic recurrent dermatoses is fraught with the danger of injury to normal tissues by cumulative effects. Caution is especially necessary in the treatment of a series of recurrences by x-rays in areas previously irradiated. The application of roentgen therapy should be restricted to those eruptions which involute and stay away for at least four to six months as the result of a few fractional doses. When lesions do not show signs of improvement after four exposures, generally the irradiation should be stopped, for undue continuation of it seems to increase the resistance of the lesions to other therapeutic measures and invites the hazard of radiodermatitis.

Various types of psoriasis exist and some of them respond to x-ray therapy better than others, the best results being obtained in subacute and chronic cases. Rapid involution is usually observed in eruptions which are variants from the prototype, especially those on the borderline between psoriasis and seborrheic dermatitis. In the acute exanthems or spreading eruptions, radiation is often irritative and detrimental, and even in stationary lesions such results are occasionally observed. These instances are, however, so rare and so overshadowed by the remarkable benefit derived by the majority of patients that roentgen therapy has become a popular remedy for the psoriatic. No other treatment can compare with it in clearing up some of the lesions, which disappear with more certainty and with greater rapidity than from any other local application. Aside from being usually effective, the treatment is

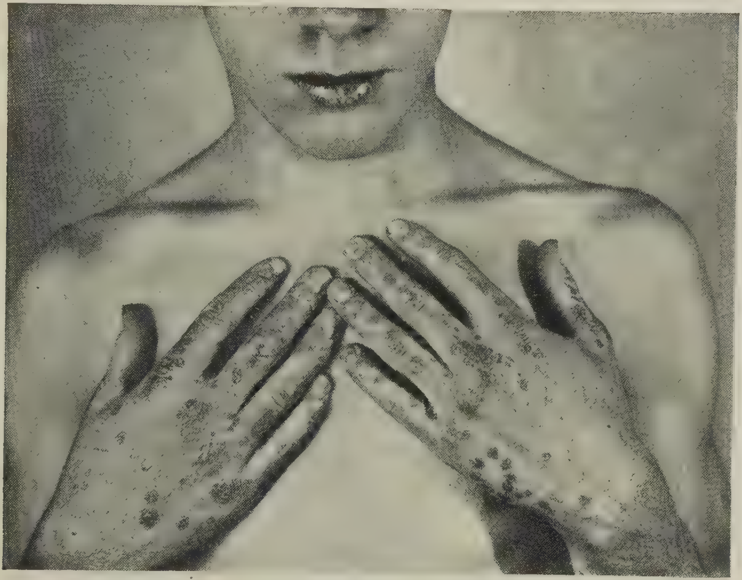

Fig. 275.—Psoriasis of the nails, backs of the hands, and of the lower lip.

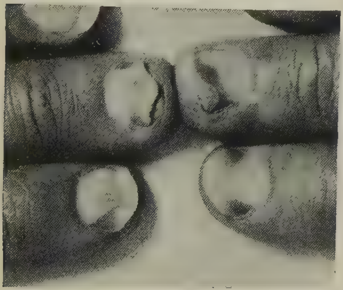

Fig. 276.

Fig. 277.

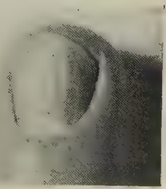

Fig. 278.

Figs. 276–278.—Psoriasis of the nails. Note the stippling, irregular transverse grooves, brownish discoloration, uplifting of the free margin, and tendency to erosion.

painless and clean and requires no exertion on the part of the patients, for which reason it is preferred by most of them to ointments, injections, and other forms of therapy. Unfortunately, some eruptions which involute promptly because of *x*-ray treatment, later, should there be recurrences, fail to be influenced at all by it; while there are others which are at all times apparently irritated detrimentally.

In the roentgen treatment of psoriasis, filtration is not commonly used. Experiments with filtered and unfiltered *x*-rays on symmetrically located lesions of similar clinical characteristics have shown no marked advantage of either quality of radiation. In the average case unfiltered or lightly filtered *x*-rays are used by most therapists, but it is customary to employ filtration in the treatment of thick inveterate patches.

Regardless of the quality of radiation, the dosage should always be below that which will provoke an erythema. Fractional doses are given at regular intervals, but it is undecided whether the effect of a full dose monthly is the same as that produced by smaller amounts given more frequently. Usually $\frac{1}{4}$ E. D. is given weekly because this gradual application is safer. When from the type of eruption irritation might be expected, even smaller doses ($\frac{1}{8}$ E. D.) are given until the tolerance is known. This dose is also frequently used on blondes and children.

No case of psoriasis should be regarded as sufficiently treated until every lesion has completely disappeared microscopically, as well as macroscopically. If treatment is stopped when most of the patches have disappeared, the few remaining ones are likely to persist and spread, and new lesions soon develop without any notable free interval between the attacks. As a rule, eight to ten weekly exposures are sufficient to produce complete involution, and when this amount is ineffective, additional exposures should be limited. If the eruption does not involute with this amount of therapy, it almost invariably fails to respond to further irradiation. When radiation is persisted in, the lesions become recalcitrant and may even spread during the treatment. Such resistance is shown not only to *x*-rays but to other therapeutic agents. After involution the site of the lesion may be whiter than the rest of the skin and surrounded by a dark hyperpigmented halo. This condition, which is known as *leukoderma psoriaticum*, is not peculiar to *x*-ray therapy, but is a persistent sequela of the disease in some persons.

In *generalized eruptions* the trunk and extremities should be divided into two or three parts, which should be treated twice a week on alternate days so that the entire integument involved is covered once weekly. The principal hazard in this kind of treatment lies in overlapping. Some overlapping, however, is desirable, but it must be insufficient to cause an erythema. These matters have been discussed on pages 132, 157, and are only mentioned here because of their particular application to the treatment of this disease.

Psoriasis of the *scalp* is treated with *x*-rays although, as a routine procedure, it is advisable to substitute *w*-rays for them for this purpose. Isolated instances of accidental epilation are convincing on this point. The limited amount of *x*-rays that can be given to the scalp without danger of epilation is too small to have an appreciable effect upon any but the mildest forms of psoriasis, which can easily be cured by simpler remedies. In severe eruptions of the scalp, the amount of *x*-rays which might be safely given is too small to be curative and only complicates the treatment by other measures; it, further, induces the temptation to give more radiation than good judgment permits, which the operator ultimately regrets. The technic of irradiating the scalp in psoriasis is similar to that described for the treatment of tinea capitis, except, of course, that the dosage is much smaller to avoid epilation. Five exposures are made to the Kienböck-Adamson points, with proper shielding of the face and ears and sufficient overlapping to produce equal distribution. The general rule is to give $\frac{1}{2}$ E. D. of unfiltered radiation to each point in two months. Even this quantity is occasionally excessive when the patient is blonde and has an unusually small head, and therefore such conditions may change the dosage. The total of $\frac{1}{2}$ E. D. may be divided into smaller portions to be given at shorter intervals, generally one eighth weekly. This distribution of the amount over several weeks decreases the hazard but also retards the progress.

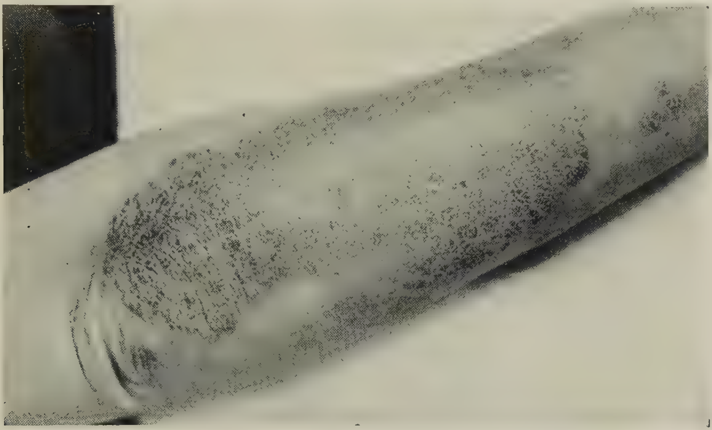

Fig. 279.

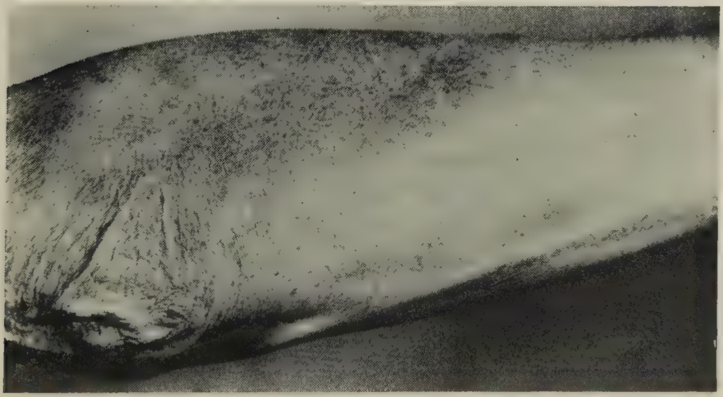

Fig. 280.

Figs. 279, 280.—Psoriasis of the elbow before and after four fractional doses of x-rays.

Psoriasis of the *auditory canals* is best treated by filtered radiation (3 mm. aluminum), two to three exposures of $\frac{1}{2}$ E. D. being given at intervals of three weeks, with the adjacent parts closely shielded. The treatment of psoriasis of the *fingernails* and *toenails* is effective, but does not manifest improvement for three to ten weeks after the initial dose. Only the tip of the digit should be treated, being exposed, together with the tissues $\frac{1}{2}$ inch proximal to the cuticle, to filtered radiation directed vertically to the plane of the nail. Exposures should be made every two weeks, $\frac{1}{5}$ E. D. being given to a maximum of six or eight treatments. The nails should be kept well greased with 5 per cent ammoniated mercury ointment.

The intertriginous type of psoriasis in the *axillae, groins, gluteal crease,* under the *breasts* or between the digits is frequently recalcitrant to radiation because of the delicacy of the skin in these regions, which requires unusual caution in dosage to avoid an erythema. This is likely to be caused by the summation of repeated small doses. It is advisable to use unfiltered *x*-rays, $\frac{1}{4}$ E. D. once weekly, for no more than six weeks. Whenever the patient's hands are used to facilitate the treatment of parts, they should be carefully shielded, as otherwise they are likely to become burned by superimposed exposures or nearness to the tube.

Thymus Irradiation.—A new form of radiotherapy for psoriasis was advocated in 1918 by Brock, who noticed the relationship between irradiation of the neck and breast and the rapidity of recurrences. Through systematic studies he was convinced of the influence of the secretions of the thymus upon the course of the disease, and that small doses applied over the thymus in almost all cases led to improvement, whereas larger amounts caused unfavorable results. With correct doses he obtained regular healing of early lesions, but had to combine the thymus treatment with local exposure to influence old inveterate patches successfully. In some cases irradiation of the thymus at weekly intervals for several exposures was necessary to effect involution. His experience was that the recurrences were rarer and took place later than after local treatment. The belief gradually gained ground that psoriasis was caused by, or related to, hypofunction of the thymus gland and that the benefits obtained by small doses of radiation were due to stimulation of its secretions, which concept is not in accord with the generally known facts about the biological effects of radiation and has not been supported by the work of Lenz, Herxheimer, Hoffmann, Martenstein, Schreus, Schneider, myself and others.

Brock irradiated the region of the thymus and thyroid, protecting the surrounding tissues with lead, giving treatments at monthly intervals with 3–4 H through 3 to 4 mm. of aluminum at a skin-anode distance of 24 cm., using 3 ma., 60,000 volts (sp. gap 12 cm.) for an exposure time of twelve minutes. The method and variations of it have also been advocated by D'Amore, Foerster, Gawalewsky, Günsburg, Mestchanski, and Rummo, who have reported good results in a large number of cases. These results have not, however, been especially convincing. The fact that frequent and occasional improvement has been observed does not mean much because of the changeableness of psoriasis. But aside from theoretical questions, there is not much practical benefit from thymus irradiation because it gives no guarantee against recurrences. The failures from it are too numerous, and the progress so slow that the patient becomes dissatisfied and demands quicker methods of treatment, so that one has to use local exposures anyway. The use of thymus irradiation to supplement local exposures is of doubtful value.

Ultraviolet Light.—Under ultraviolet therapy some psoriatics improve remarkably and others fail to respond. One meets with successes and failures in all types, so it is difficult to give a correct prognosis before the beginning of treatment, but after a few weeks it is possible to do so. Usually there is a gradual improvement and often a complete disappearance of the symptoms, but unfortunately there are many recurrences. Patients who have not had a previous attack and those in whom the onset has been rapid, respond best. In fact, in all acute cases of psoriasis ultraviolet radiation together with soothing lotions and salves should be used until the inflammation has subsided, at which time it is safe to apply a few exposures of *x*-rays, if necessary. In persistently recurring cases ultraviolet light may be used liberally, whereas *x*-rays are apt to produce injuries.

Locally the carbon or mercury arc lamp may be used to produce the second degree reaction, which is necessary to obtain benefit. In thickened patches the water-cooled lamp with compression may be advantageous, as its use shortens the necessary exposure time. The skin about the lesions should be well protected. It has been my impression that a few tonic generalized exposures of ultraviolet light given weekly after the disappearance of extensive psoriasis from treatment by ointment or x-ray materially prevent relapses. Actinotherapy is particularly useful in the intertriginous type of psoriasis, which responds so poorly to other measures. The inveterate form is benefited only by intensive treatment, the scaling gradually ceasing and the lesions being replaced by normal skin. To summarize, the superficial, slightly infiltrated forms, especially in fresh eruptions, respond better than long-standing thick plaques.

Radium.—The use of radium in psoriasis is limited to small isolated patches on the scalp, exposed parts or scrotum, in which locations half-strength flat glazed applicators, screened only with 0.1 mm. aluminum, are employed for ten to twenty minutes, in divided doses of five minutes once weekly. When the aural canal is involved, a silver tube covered by 1 mm. of rubber may be placed within it and left 40 to 50 millicurie hours, with excellent results.

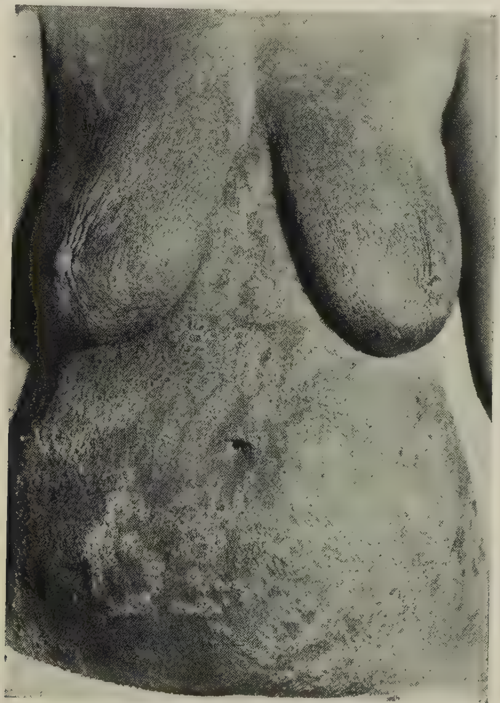

Fig. 281.—Extensive psoriasis. This type is likely to change into exfoliative dermatitis, especially if injudiciously treated.

w-Rays.—Similar to the use of flat radium applicators, the w-rays are suitable only for the above-mentioned parts, where, for the sake of expeditious relief or avoidance of epilation or possible injury to deeper structures, such easily absorbable radiation is advisable. The dosage must be fractional without provoking sharp local reactions, usually with 8 ma., 8 kv., an exposure of three or four minutes, and an anode-skin distance of 8 cm., weekly.

In addition to local measures, various *internal remedies* may be used alone or in conjunction with radiotherapy. Of these, injections of vaccines such as nonspecific proteins seem most beneficial. Marcus has cultivated the Streptothrix from the lesions and has demonstrated splendid results from hypodermic injection of vaccines prepared from this organism. I have one patient who has been completely free from lesions for six years after thorough treatment with an autogenous stool vaccine. She had been affected for ten years with generalized psoriasis and had received treatment by numerous other methods, including radiation. Sutton has had uniformly good results from autogenous colon vaccine, and the liberal use of chrysarobin ointment. He has reported a series of 42 cases thus treated. Other forms of protein therapy including injections of aolan, sterilized milk and autohemotherapy seem to augment the resistance of the body to the disease. Vercellino has even had good results from hypodermic injections of extracts of the skin lesions. Sodium salicylate, gold sodium thiosulphate, and strontium bromide have been given intravenously, the latter not without some benefit in acute cases. Intramuscular injections of arsenic, bismuth or thymus extract are accepted procedures. Many of these remedies may also be given by mouth, in which case they may be less effective. Other drugs given *per os* are thyroid extract, colloidal sulphur, salicin, arsenic, and potassium iodide.

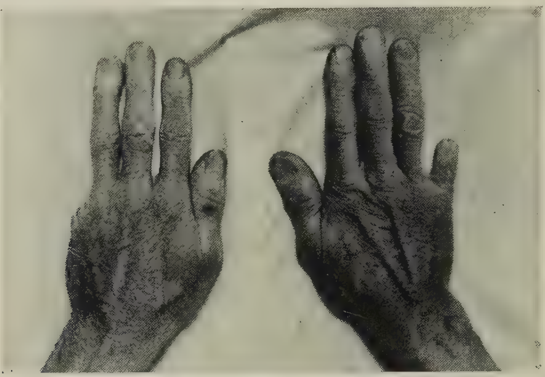

Fig. 282.—This psoriatic received arsenic for long periods. He developed arsenical keratoses and epitheliomas, for which the amputations were made, but his doctor did not know that these lesions were caused by arsenic, and was still treating him with the drug when he applied at the hospital for the treatment of an epithelioma of the right middle finger.

To be effective arsenic must usually be given in doses sufficiently large to cause signs of arsenical intoxication, puffiness of the eyelids, face or ankles, or neuritis. These symptoms are not of themselves dangerous and can be easily controlled by stopping the arsenic. However, psoriasis is a recurrent disease and persons who have been benefited once by arsenic are likely to seek further relief from it and through repeated arsenic consumption over a period of years, to become victims of the carcinomas it generates. Arsenic for psoriatics, therefore, holds hazards analogous to those of x-rays.

PARAPSORIASIS

Synonyms.—Chronic resistant and scaly erythrodermias, parakeratosis variegata, pityriasis lichenoides chronica, erythrodermie pityriasique en plaques disseminées, dermatitis psoriasiformis nodularis.

The term "parapsoriasis" was applied by Brocq to a group of maculopapular scaly erythrodermias of slow evolution, whose marked chronicity, resistance to treatment and absence of subjective symptoms were characteristic features. Whereas the eruptions were psoriasiform and lichenoid, the diseases did not correspond to psoriasis, lichen planus or other recognized dermatoses, and although the details of the eruptions did not harmonize, there was sufficient essential conformity to place them in a distinct group. Brocq divided parapsoriasis into three varieties: guttate, lichenoid, and patchy (en plaques).

In the guttate variety, erythematous, yellowish scaly spots appear insidiously and persist indefinitely without change, chiefly on the sides of the trunk, thighs, and upper arms; although from time to time the eruption may be augmented by the development of a few new lesions. The affection may be confused with psoriasis and with secondary syphilis. In the lichenoid variety, there is an orderly reticulation of the skin formed by flat-topped scaling papules, which resemble those of lichen planus. The sides of the neck, the upper trunk and the limbs are favorite sites. The course is slowly progressive, with occasional remissions and exacerbations. The plaque variety occurs chiefly on the trunk and thighs, where round, well-defined, varicolored smooth or slightly scaly patches are seen. A characteristic feature is the impressive color of the lesions—brown, yellowish-red, and purple.

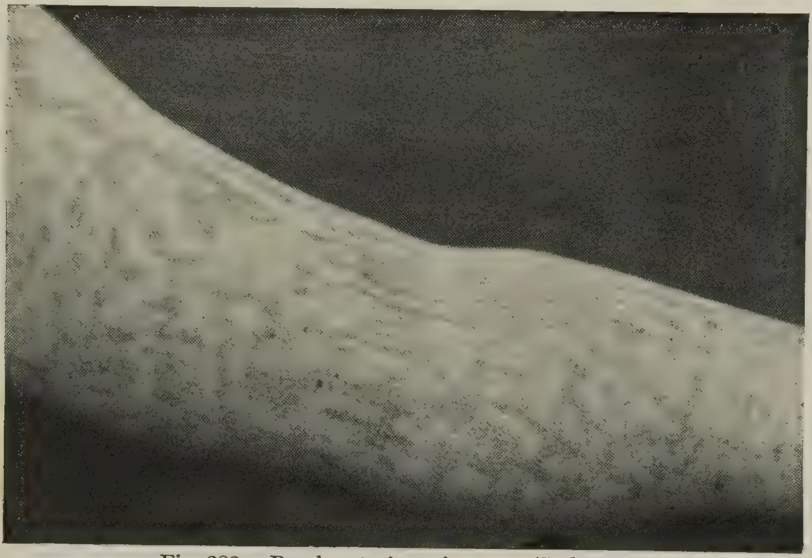

Fig. 283.—Parakeratosis variegata. (Stelwagon.)

Treatment is usually ineffective, the different internal remedies which have been used in psoriasis and lichen planus having been given without marked benefit. Occasional successes from certain local remedies warrant their use in all cases. Of these the most effective are strong keratolytics, especially chrysarobin or pyrogallol. In widely disseminated cases these drugs should be used with caution because they may cause exfoliative dermatitis or nephritis. Of the physical remedies ultraviolet light has received the most credit. It has been particularly effective in the guttate variety of the disease, and experience has shown that intensive doses are necessary for good results. In the lichenoid type it is my impression that there were better results from fractional *x*-ray treatment. I have treated four patients with the en plaques variety vigorously by ultraviolet light and x-rays without any improvement, although one patient was completely cured later by the application of 20 per cent chrysarobin in chloroform.

GENERALIZED EXFOLIATIVE DERMATITIS

Synonyms.—Dermatitis exfoliativa, pityriasis rubra.

This affection of the skin may occur independently or secondary to some preceding dermatosis and is characterized by a universal obstinate scaling, itching erythrodermia usually associated with loss of the hair and nails. The condition may apparently be produced by several different agents. Primary cases occur rarely and start with erythematous swollen patches, which spread rapidly until the whole integument is involved. The onset is accompanied by symptoms of general intoxication. Desquamation is evident after a few days, and the scales are branny or very large. In the secondary cases the onset and spreading are less dynamic. The condition is often superimposed upon intractable psoriasis or eczema that has been overtreated, or may come from other forms of dermatitis due to general intoxication (from arsenic, leukemia, *et cetera*). Generalized exfoliative dermatitis is frequently grave in children and elderly people.

Pityriasis rubra (*Hebra*) is an extremely chronic variety in which the scales are small, infiltration is absent and atrophy ultimately supervenes. This type, perhaps a tuberculide, progresses slowly to a fatal termination.

Epidemic exfoliative dermatitis (epidemic skin disease) was described by Savill, in 1891, and sporadic cases have since been reported. Ritter's disease (dermatitis exfoliativa neonatorum) is another rare condition, observed mostly in institutional babies, beginning during the first five weeks of extra-uterine life. It is not contagious and begins with a localized redness about the mouth, which becomes universal, and is accompanied by exfoliation and eczematization. In most cases the epidermis can be rubbed off the involved areas. The constitutional symptoms are slight but the disease is often fatal, death occurring from exhaustion and intercurrent complications. Guy and Cohen have recently reported fully on the condition.

Treatment.—The patient should be placed in bed and given a régime of tonics and elimination. Sedatives may be beneficial at the beginning. Local treatment should be soothing. The skin may be painted every hour with carron oil containing 5 per cent ichthyol, ½ per cent phenol, and glycerin. Creams containing mild stimulants and antipruritics are of value.

Of the physical agents fractional doses of unfiltered x-rays are by far the most effective and even these do not produce improvement in all cases. The best results from x-ray treatment have occurred in exfoliative dermatitis due to arsphenamine. I have treated five patients with such eruptions and in only one failed to obtain striking relief from the first fractional dose. Caution must be observed in the technic of administration and dosage, for otherwise the toxicity of the patient may be increased by overirradiation.

PITYRIASIS RUBRA PILARIS

Synonyms.—Lichen ruber, lichen ruber acuminatus, pityriasis rubra pilaire (Devergie).

This is a chronic skin disease characterized by small follicular papules and disseminated erythematous scaling patches. The papules are the most important diagnostic feature, being more or less acuminate, reddish brown and about pinhead size, and topped by a central horny plug. In the horny center a hair, or part of one, is usually embedded. The disease generally first manifests itself by scaliness and erythema of the scalp. The eruption is discrete in the beginning, having a predilection for the sides of the neck and trunk, and the extensor surfaces of the extremities, especially the backs of the first and second phalanges. Then as new lesions occur, extensive areas are converted into grayish, rough, scaly patches of various sizes which look like exaggerated goose-flesh and feel like a nutmeg grater. Any portion of the

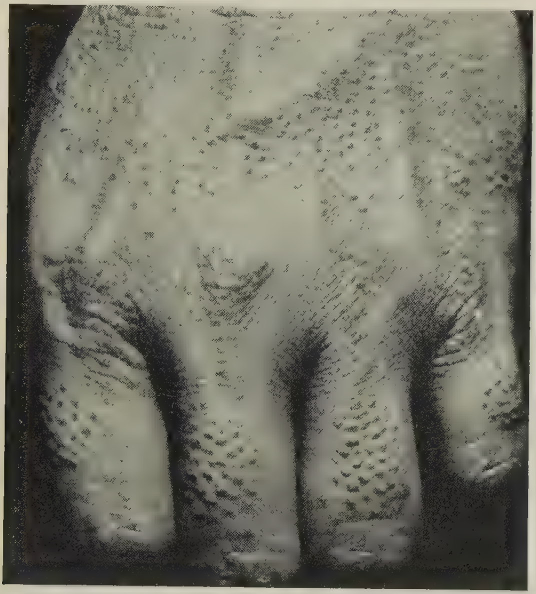

Fig. 284.—Pityriasis rubra pilaris. Typical follicular papules on the backs of the proximal phalanges. (Courtesy of New York Skin and Cancer Hospital.)

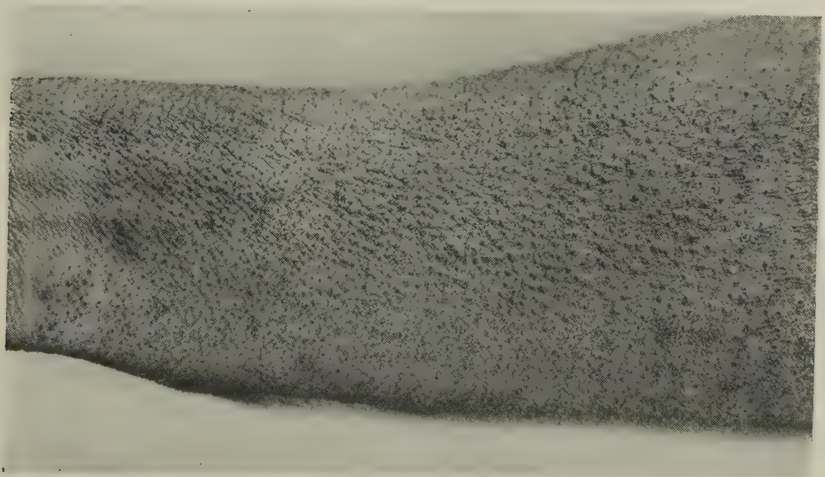

Fig. 285.—Pityriasis rubra pilaris. (Courtesy of Dr. H. W. Barber, London, England.)

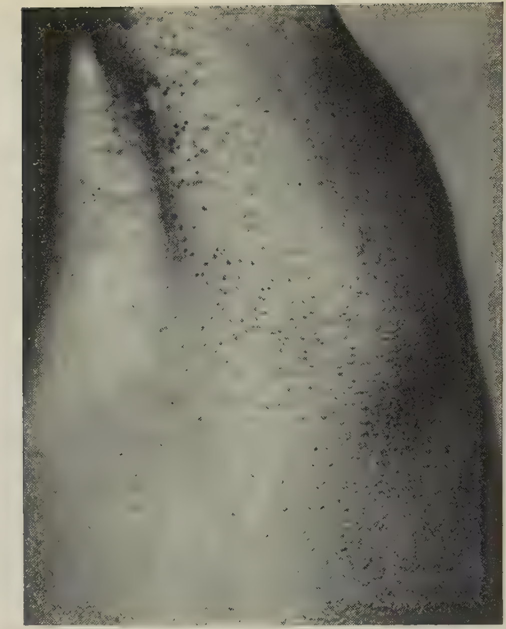

Fig. 286.—Pityriasis rubra pilaris of the lower part of the axilla. (Courtesy of Dr. Isaac R Pels.)

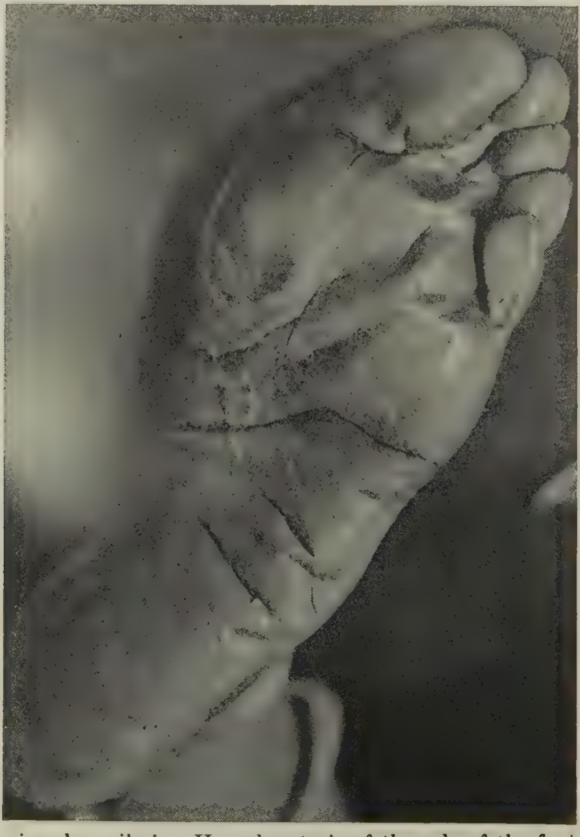

Fig. 287.—Pityriasis rubra pilaris. Hyperkeratosis of the sole of the foot. (Courtesy of Dr. Samuel T. Millard.)

body area or the entire surface may be affected. The involvement is generally symmetrical. There is a hyperkeratosis of the palms and soles, with a tendency to fissures. The nails may be dull, rough, thickened, brittle, and striated and are apt to crack and break.

There are no subjective symptoms except more or less itching. The general health ordinarily is not affected. The disease may be slowly or rapidly progressive for years with periods in which it may remain stationary for a time, or it may regress, eventually disappearing entirely.

The diagnosis of pityriasis rubra pilaris is rarely difficult because of its distinctive features, such as the follicular papules, containing a horny center, on the backs of the fingers, sides of the neck and extensor surfaces of the limbs; the thickened, rough, and slightly or moderately scaly harsh skin, and the hyperkeratosis of the palms and soles. It is distinguished from psoriasis by the scales in the latter being silvery, light, and overlapping like shingles, and the papules extending peripherally to form the patches. The palms and soles are seldom involved in psoriasis. Lichen planus has characteristics such as shiny scaly plaques of a violaceous or dark-red hue, and flattened discrete papules, and, exceptionally, involvement of the face, scalp, and palms.

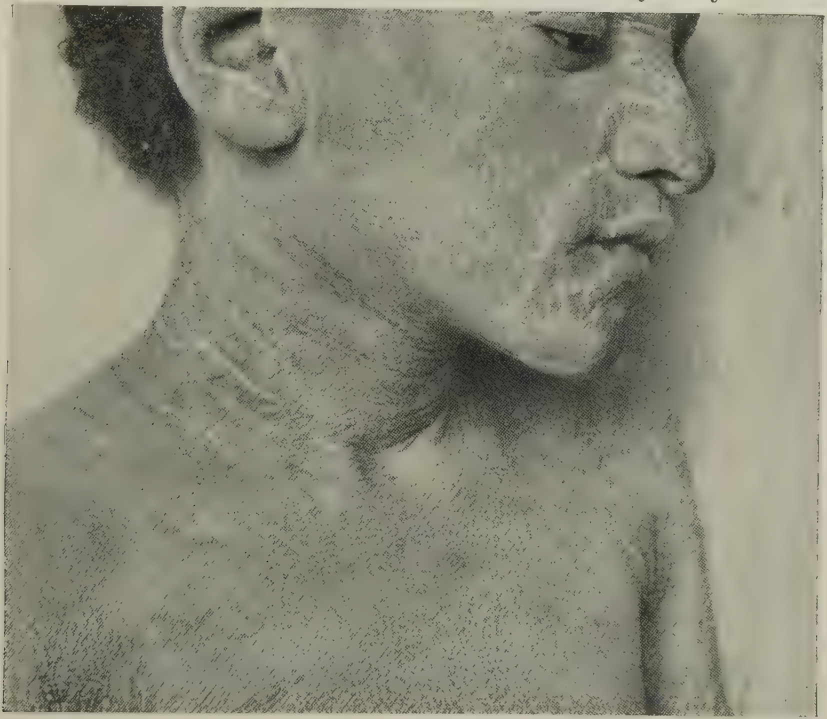

Fig. 288.—Pityriasis rubra pilaris in a mulatto girl, involving the entire surface. (Stelwagon.)

The etiology is unknown. A tuberculous origin has been ascribed to it, but the evidences are not conclusive. There seems to be a familial tendency, instances being reported in which several members of one family have been affected. Either sex may be attacked, males, however, more frequently than females.

Treatment.—This is largely palliative, being both internal and local, and conforming generally to that of psoriasis. Bran or starch baths or alkaline baths, applications of oil or ointment containing a keratolytic remedy, and the administration of tonics are beneficial. Arsenic has been used with varying results, so that it is considered unreliable, and is not to be recommended because it may produce or aggravate hyperkeratosis. The results of radiotherapy have not been encouraging, although temporary benefit may be derived from it.

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CHAPTER XVIII

LICHEN PLANUS

Synonym.—Lichen ruber planus.

Lichen planus is an inflammatory disease of the skin and mucous membranes of unknown origin characterized by distinctive papules which have a predilection for the flexures, where they tend to be grouped into irregular, annular, and linear patches. The diagnostic papules are small flat, polygonal glistening facets lying between the natural lines of the skin, and are of a characteristic violet color. The surface of the lesions is dry and shiny, with a tendency to scaling. The elementary lesion is almost pathognomonic. It is about the size of a pinhead or a little larger and is only slightly raised. On close examination, toward the center of the papule there may be seen a slight depression or a small horny plug at the site of a pore. With a lens one can make out glistening white striae (Wickham) which form a network on the surface of the papule; these become more visible when the surface has been moistened with water. The angular outline of the lesion deserves special consideration. The papules being confined to the natural lines of the skin exaggerate the normal texture so that these lines appear to be deep furrows; and a group of papules seems to form a mosaic cut by criss-cross lines. The color varies from red to purple but is most commonly bluish lavender. In older patches a brownish tint may be present and there may be coalescence and considerable scaling which may more or less hide the elementary lesions, thus making close examination at the edge of the patch necessary to discover the typical, flat-topped, shining papules. After the lichen planus lesions have disappeared, deep pigmentation is likely to persist for several months. The pigmentation is often so intense that a diagnosis of the antecedent disease

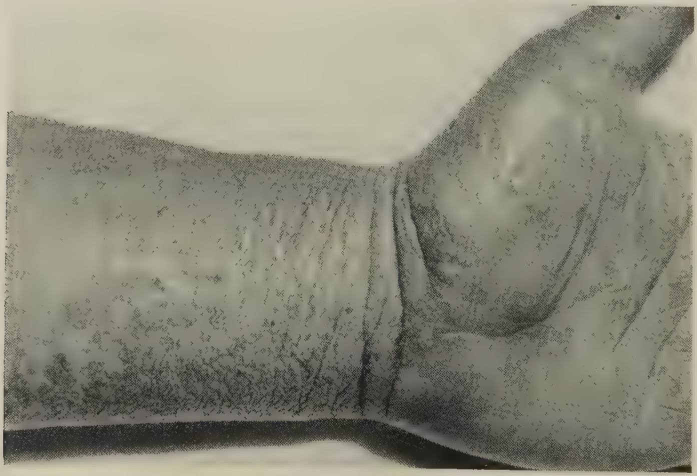

Fig. 289.—Lichen planus.

can be made from its distribution. It is increased by the use of arsenic, which is sometimes given for treatment of the disease. Occasionally depigmented atrophic spots are left. On the mucous membranes, particularly on the buccal mucosa and on the glans penis, lesions may appear before there are cutaneous evidences of the disease, or may even exist without skin involvement.

Clinical Types.—Two chief types of lichen planus are recognized: the acute widespread variety and the chronic localized variety. The acute exanthem often begins on the inner surfaces of the arms and rapidly spreads, involving large areas of the body, with predilection for the abdomen, lower back, thighs, and forearms. The onset is sometimes accompanied by fever and other constitutional symptoms, but as a rule these are negligible. The acute outbreak may be preceded for months or years by one or two small patches of the disease. In severe cases, the papules appear so densely that the skin becomes diffusely erythematous and edematous. Vesicopapules and even bullae have been observed. It is a common impression that vesiculation occurs most often in patients who have been treated by arsenic. Widespread eruptions persist for a few months and then have a tendency to subside spontaneously. Not infrequently a few patches may remain as a localized chronic variety, the shins being a favorite location for such lesions.

Fig. 290.—Lichen planus eruption magnified. Characteristic flat-topped, angular, shiny papules.

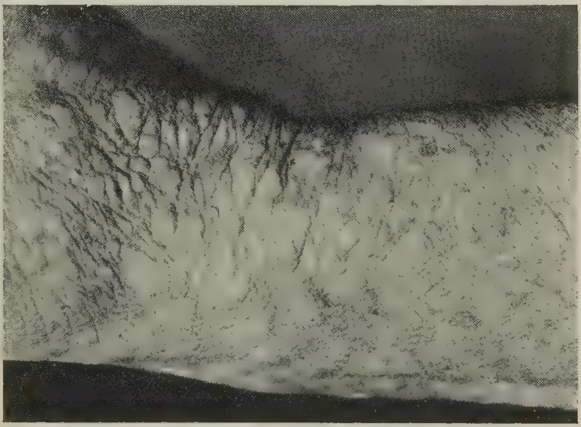

Fig. 291.—Typical lichen planus lesions on the wrist.

The chronic type of the disease is of more common occurrence and its course is characterized by periodic exacerbations, during which new lesions appear and the eruption spreads. The areas involved are comparatively limited. The affection usually involutes somewhat after persistence for several months or years, or the lesions may become hypertrophic.

Lichen planus verrucosus is a term applied to the hypertrophic variety of the disease, which occurs most commonly on the shins. The patches consist of verrucous plaques covered with fine adherent scales. At the edges of the patches, small flat-topped polygonal papules may be discovered upon careful search, but upon superficial inspection the lesion often suggests psoriasis rather than lichen planus. The patches are usually palm sized or larger, but may be nummular. The differential diagnosis is made from the color of the patches, their thickening and small adherent scales, the itching, and the symmetrical location on the shins, usually without being associated with any other skin lesions.

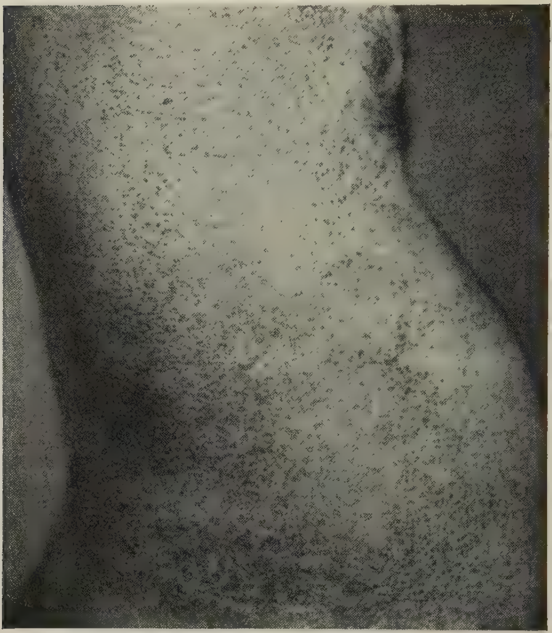

Fig. 292.—Lichen planus. Generalized exanthem.

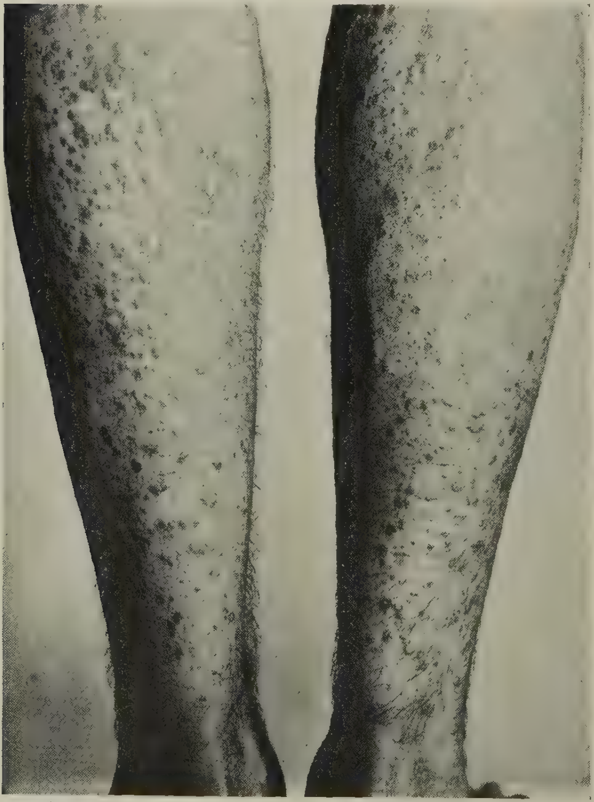

Fig. 293.—Hypertrophic lichen planus of the legs.

Many variations from the above forms occur. Linear lesions composed of single rows of characteristic papules are often found on the extremities. appearing in scratch marks. Linear patches, sometimes thickened and covered by extensive scaling, may also be present. Annular lesions may be a prominent feature of the eruption,

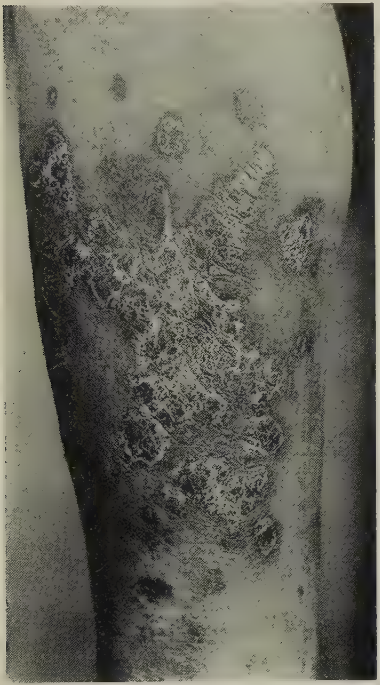

Fig. 294.—Chronic patch of lichen planus resembling psoriasis, the front and sides of the legs being a common location.

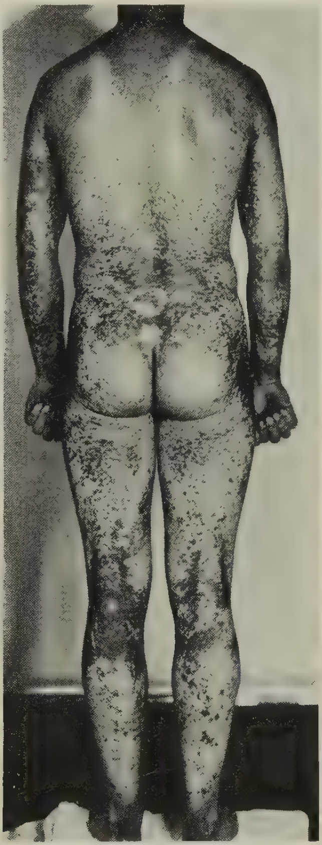

Fig. 295.—Pigmentation following lichen planus.

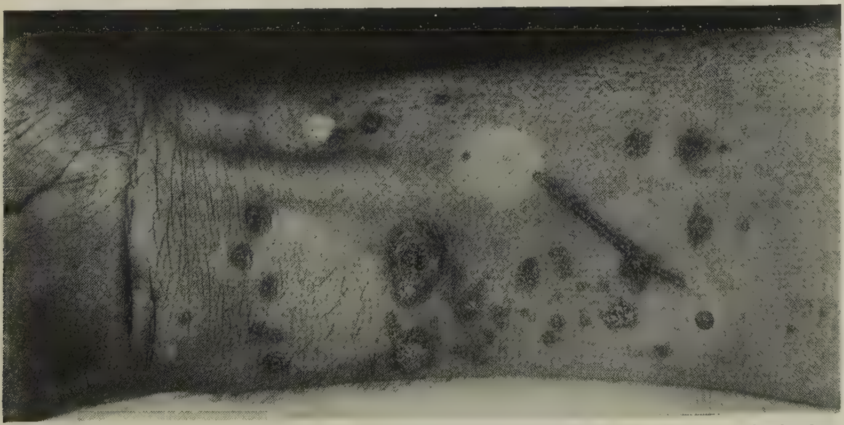

Fig. 296.—Linear lesion composed of contiguous papules; annular lesions and leukodermic spots in lichen planus.

being commonest on the forearms. The rings, usually about 1 cm. in diameter, are composed of aggregations of flat papules.

Lichen planus linearis is a term applied to an exaggerated linear form of the disease in which bandlike patches occur. The arrangement occasionally suggests zoster. The patches are more or less stationary and are very pruritic, extending somewhat like a linear nevus along an extremity or about the trunk. A common situation is along the posterior aspect of a lower extremity.

Lichen planus atrophicus is characterized by atrophic alterations in the skin, which give it a semblance to morphea. In this type the papules are usually flat and difficult to find. Close inspection will reveal their angular outlines and often a prominent central umbilication. Aggregations of these lesions form small ivory or violet-colored patches, about which there may be a zone of erythema, and these may simulate morphea guttata. The involvement may be widespread leading to a condition which has been described as "white spot disease."

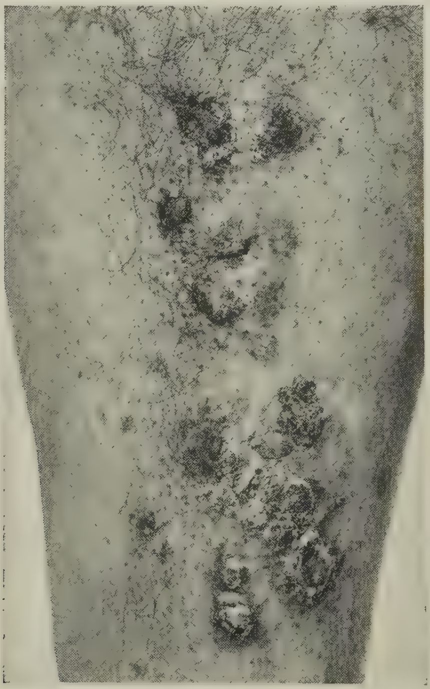

Fig. 297.—Lichen planus verrucosus.

Lichen obtusus corneus is an unusual type of hypertrophic lichen planus, which appears on the legs and wrists in the form of circumscribed, rounded, verrucous nodules, about 1 cm. in diameter. They are a dull brownish-red color, incompressible and slightly scaly. Itching may be slight or unbearable. The distinction between lichen obtusus corneus and prurigo nodularis is vague, and the two terms are thought by some authorities to apply to the same disease.

Lichen planus bullosus is the variety previously described in which vesicles and bullae form a part of the eruption. These manifestations are unusual and do not materially influence the course of the disease or the treatment.

Other rare types of lichen planus are *lichen planus erythematosus,* in which the lesions are unusually congested and soft; *lichen planus moniliformis,* in which hypertrophic nodules are arranged in streaks so that the appearance suggests a string of beads; and *lichen planus haemorrhagicus,* in which the lesions are hemorrhagic. Sometimes the lesions of lichen spinulosus are found associated with eruptions of lichen planus.

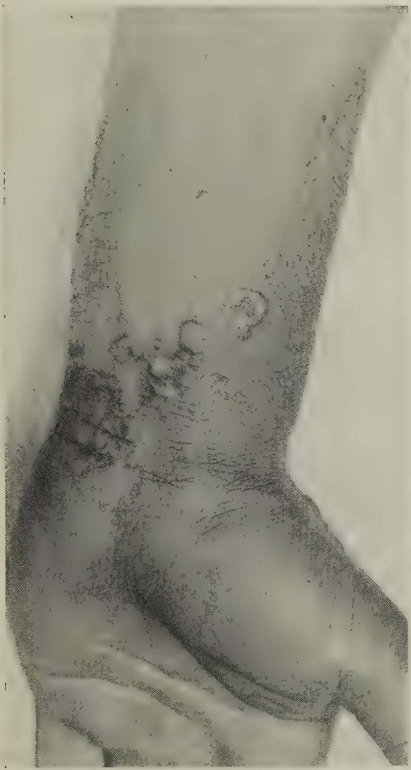

Fig. 298.—Lichen planus annularis. A common location.

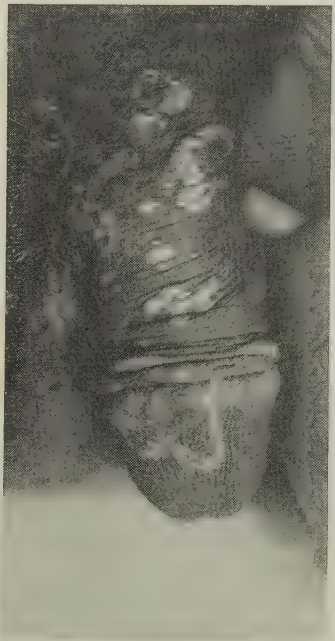

Fig. 299.—Ringed lesions in lichen planus.

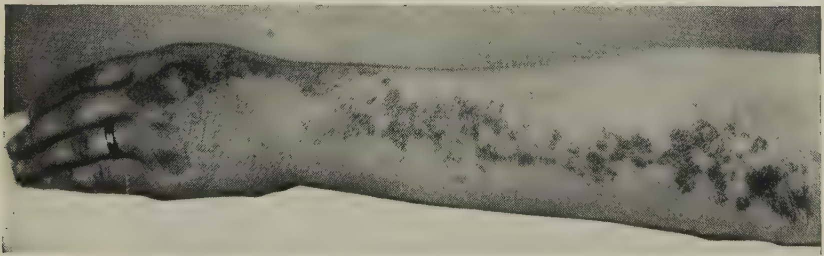

Fig. 300.—Lichen planus linearis.

Symptomatology.—Itching is generally an outstanding symptom in lichen planus, often being almost intolerable in the acute cases. The pruritus occurs in spasms, and causes a frenzy which lasts for a few minutes and then gradually subsides. Some eruptions may not itch at all and others only slightly.

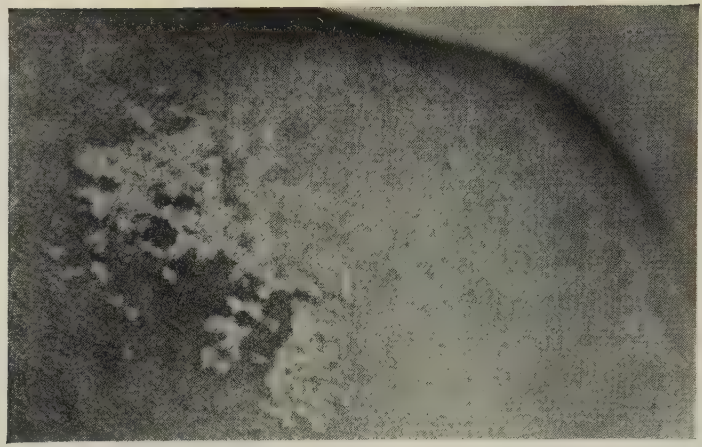

Fig. 301.—Lichen planus atrophicus. Note individual angular atrophic papules.

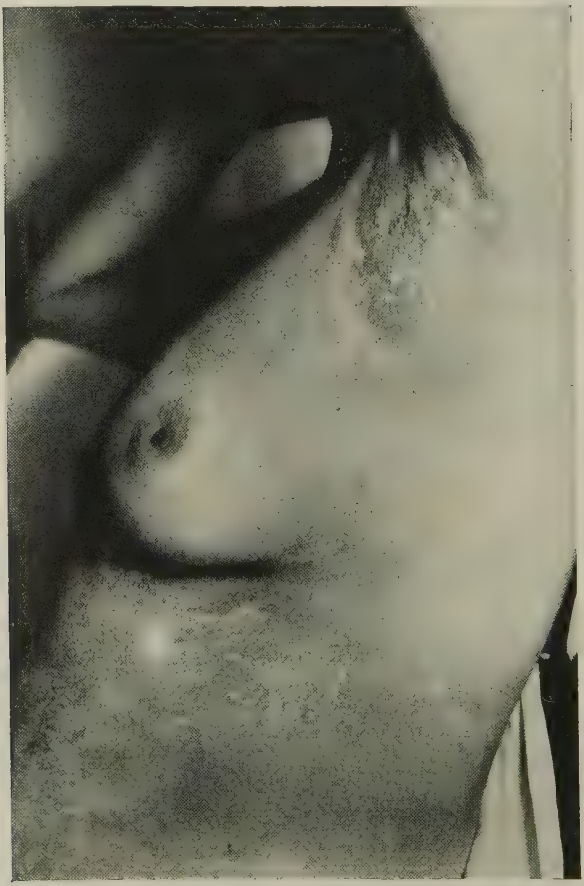

Fig. 302.—Widespread lichen planus atrophicus. Note individual white spots, angular in shape.

The disease may appear on any part of the body, but rarely on the face, the head, palms, and soles. Subungual papules may cause a thickening and malformation of the nails. The mucous membranes are frequently affected and in these locations the lesions have a different appearance. Cases of lichen planus of the mouth, without lesions on other parts of the body, have been described. The lesions are usually located on the inner sides of the cheeks and consist of milky-white papules, the size of a pinhead or smaller, which form annular or linear patterns or appear as discrete puncta, or, more commonly, aggregations of them form irregular patches which have a reticulated appearance. Similar lesions may occur on the palate, lips, and tongue, but in the last two locations they are less characteristic and may be mistaken for leukoplakia. On the glans penis they are usually definite, consisting of flat, angular papules, which may be arranged in rings. On the labia similar lesions are observed, which are generally whitish due to contact with the opposite part.

Lichen planus is rare in children, and in adults is, as a rule, persistent and recalcitrant to treatment, with a tendency to relapses. The hypertrophic and linear varieties often persist indefinitely in spite of treatment. In the acute and chronic widespread eruption the results of treatment are usually satisfactory.

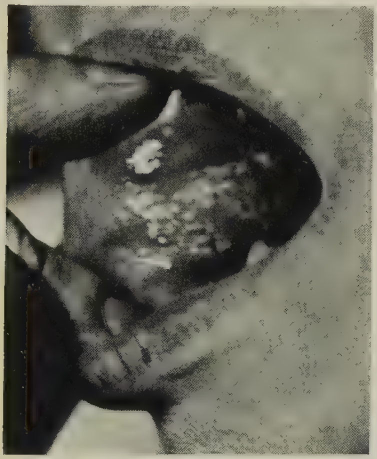

Fig. 303.—Lichen planus of the buccal mucosa. Note individual papules.

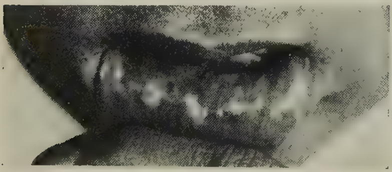

Fig. 304.—Lichen planus of the lower lip, simulating leukoplakia.

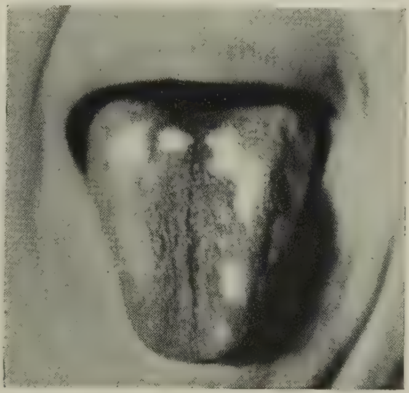

Fig. 305.—Lichen planus of the tongue.

Although the cause of lichen planus is unknown, numerous clinical observations have confirmed the fact that it frequently occurs in persons who are under nervous strain. The régime of treatment therefore requires recreation in the open and relief of worry or responsibility, so far as it is possible, together with careful directions regarding sleep, food, and elimination. The diet should be simple with avoidance of alcohol or other stimulants. Tobacco should not be excessively used. Shellfish, strawberries or other foods which might increase the pruritus should be avoided. In some cases hyperglycemia or glycosuria has been present and for this reason it is advisable to examine the urine and blood sugar content. The work of Pautrier tends to exclude microbic origin. Focal infections, however, should be searched for and treated.

Treatment.—The treatment of lichen planus is principally by three agents—arsenic, mercury, and *x*-rays. The mercury and arsenic may be administered in a combination called enesol, which is given intramuscularly in doses of 5/100 grain every other day. Both soluble and insoluble compounds of mercury are effective, the bichloride of mercury in aqueous solution or the salicylate of mercury in oil being commonly employed. The bichloride is given daily in doses of 1/12 grain, and the salicylate twice weekly in doses of 1 grain. Arsenic may be administered in the form of sodium cacodylate or neo-arsphenamine. Pollitzer's formula of 2 per cent arsenous acid with ½ per cent carbolic acid has received general approval for this purpose. It is given hypodermically with a dose starting at 4 minims and gradually increased to 30 minims over a period of about three weeks. The high dosage is maintained for approximately another three weeks and then the injections are usually stopped. The patient should be watched for signs of arsenical intoxication, especially edema about the eyes. The itching of small patches may be controlled by the local injection of benacol.

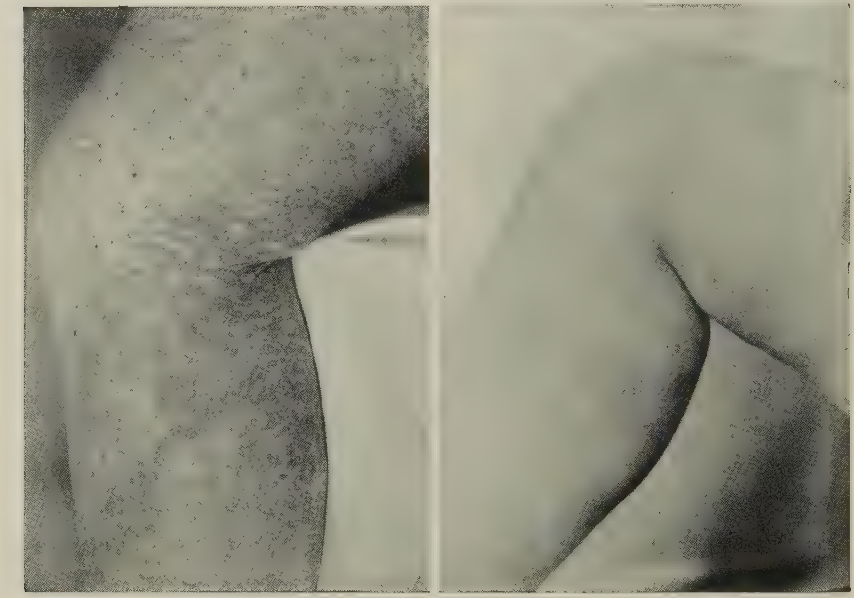
Fig. 306. Fig. 307.

Figs. 306, 307.—Lichen planus of the knee. Before and after six fractional doses of *x*-rays.

Beneficial effect on the cutaneous lesion by ultraviolet therapy has been reported by Juster and Tchiprout and others, but in my experience the results have not been striking enough to warrant its recommendation.

x-Ray Treatment.—For the acute or chronic widespread eruptions, the integument should be divided into areas as in other generalized dermatoses. Fractional treatment consisting of ¼ E. D., unfiltered, should be given to all affected areas once weekly. From four to eight weeks are usually required for the itching to cease entirely and for the eruption to involute. Disappearance of the lesions is generally followed by hyperpigmentation. During treatment antipruritic lotions containing phenol, camphor, menthol, dilute hydrocyanic acid and liquor carbonis detergens may be used.

Radicular radiotherapy has been recommended by numerous French authors for the treatment of lichen planus on the basis that the disease is definitely related to the nervous system. Cottenot and Pautrier have reported good results, with subsidence of the pruritus and disappearance of lesions in the mouth, as well as on the skin. Gouin and Bienvenue have supplemented their findings. Schoenhof has reported 10 out of 12 cases of generalized lichen planus cured by indirect *x*-ray treatment; in 2 cases the mucous membrane lesions also disappeared. The results of the work of these men have not been confirmed by many investigators, including myself, and there is at least reasonable doubt as to whether there is any benefit in lichen planus from exposures over the spinal cord and nerve roots. Interpretation of the results is always difficult because the disease often involutes spontaneously, or the patients under spinal treatment are receiving other remedies either internally or externally. The technic is as follows, although variations are made by different workers. The patient is laid upon his face and the spinal region is divided into eight fields, four on each side of the spinal column. These fields are approximately 6 inches in length by 2½ inches in width and are separated by 1 inch from each other. The radiation is directed obliquely from without inward so that it cross-fires at the imaginary level of the spinal cord, the angle of incidence being about 45 degrees. The radiation should be filtered, preferably through ½ mm. of copper, with an anode-skin distance of 50 cm., and 180 kv., rendering the depth dose as large as possible in proportion to the skin dose. One half of an erythema dose should be given to each field at intervals of three weeks until all have been covered three times, the entire series of treatments being given during a period of seven weeks.

Treatment of Special Forms.—In chronic lichen planus of the hypertrophic or verrucous type, very few cures are obtained without exceedingly persistent treatment. Preliminary curettage, or the use of liquor potassii, 5 to 10 per cent, rubbed into the area thoroughly with cotton so as to remove the horny thickening, is advisable. This should be discontinued when *x*-ray treatment is begun. Salicylic, chrysophanic, and pyrogallic acids are effective but should also be stopped during *x*-ray treatment. Chronic verrucous lichen planus is so recalcitrant to any form of therapy that fractional dosage must often be given weekly for three or four months. Although erythema, atrophy, and telangiectasis are preferably avoided, the disease is so stubborn that they may be warranted if the patch is small. The lesion therefore should be carefully shielded from the adjoining normal skin in order that only the diseased area will be affected. Exposures of one erythema dose given monthly, or one half erythema dose given at intervals of two weeks, seem to have a value indistinguishable from the fractional weekly dosage and may be more convenient. In this type of disease, filtration is often used and theoretically it would seem indicated. Practically, it seems doubtful if it is superior to the effect of the unfiltered *x*-rays, and as the cure of these lesions requires rather persistent treatment and large dosage, often near the shins where the bone is close to the skin, there are some advantages in unfiltered irradiation. Annular, linear, and bullous eruptions respond to fractional unfiltered roentgen rays.

Lesions on the genitals are of frequent occurrence. Although they are noted more often in males, I believe they are often overlooked in females. On the genitals radium plaques may be used to advantage instead of *x*-ray treatment. The plaques should be lightly filtered and suberythema or mild erythema exposures should be given. With a filtration of 1 mm. of aluminum with strong applicators, a dosage of 1 to 200 millicurie minutes should be given to each square centimeter of diseased tissue. When the involvement is extensive, *w*-rays are preferable to *x*-rays or radium, because there is less likelihood of skin atrophy from them. The dosage should be suberythema as reactions in this location are painful. It must be remembered that skin previously irradiated with *x*-rays or radium will tolerate only minute amounts of *w*-rays; consequently it is safer to have an interval of about two months between previous irradiation and the institution of *w*-ray therapy. The effects of *w*-rays are also cumulative, and as a result severe reactions may be produced by small amounts given at weekly intervals. In general, a dosage of three minutes' duration with the window 2 cm. from the skin surface, and with 8 ma. and 8 kv., may be repeated weekly for five or six times without provoking a skin reaction, and this amount is usually adequate for the treatment of lichen planus.

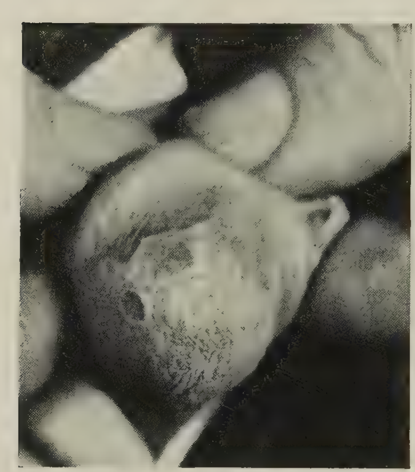

Fig. 308.—Lichen planus, annular lesions on the glans penis.

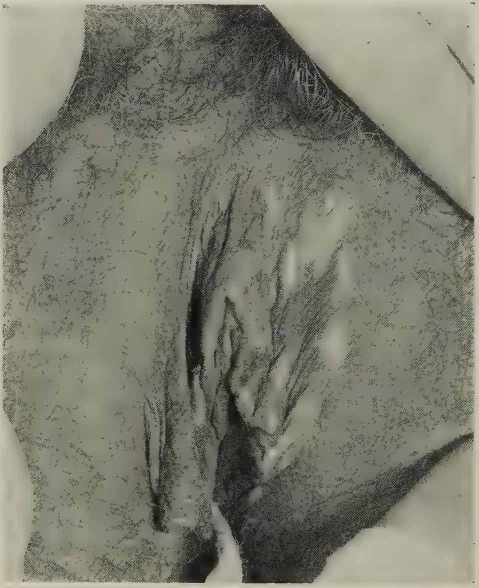

Fig. 309.—Lichen planus, characteristic lesions on the vulva.

On the mucous membranes of the mouth and lips, lichen planus is best treated by unfiltered radium in the form of a flat applicator in doses of 40 to 60 millicurie minutes per square centimeter. Such an exposure causes a mild reaction of the mucous membrane, which disappears in about two weeks, with simultaneous complete involution of the lesions. Systemic treatment with mercury or arsenic by injections should be given in addition to applications of radium.

LICHEN NITIDUS

Lichen nitidus is a chronic inflammatory disease characterized by minute, shiny, flat-topped, pink, reddish, yellowish-red or flesh-colored papules, which are rarely larger than the head of a pin, and have a predilection for the genitals and flexure aspects of the joints, although they may occur in any region. The lesions are at the beginning discrete and often remain so, being in such cases localized to a few areas, chiefly the penis, the lower abdomen, the inner surfaces of the thighs and the flexure aspects of the wrists and forearms. In other cases the affection assumes a more widespread distribution and the elementary papules become fused into erythematous, finely scaly patches. The reddish color varies with tints of yellow, brown or violet. This widespread type of eruption affects principally the groins and thighs, the ankles and wrists, the feet and hands, the submammary region in women, the folds of the neck and the extensor surfaces of the elbows. At the periphery of the patches there may be a few outlying discrete elementary papules, which can be readily identified, and Barber states they may be even discerned in the central portion of the patch by putting the skin on the stretch. Grayish minute, flat papules have been described on the buccal mucous membrane. Barber had a case associated with marked hyperkeratosis of the palms and soles.

The course of lichen nitidus is slowly progressive, with a tendency to remissions. The lesions may remain stationary for years, and sometimes disappear entirely and spontaneously.

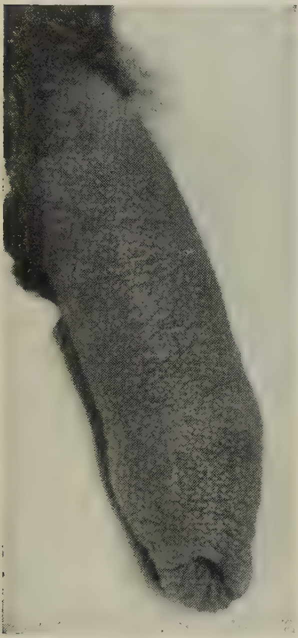

Fig. 310.—Lichen nitidus. (Courtesy of Dr. Edward R. Maloney.)

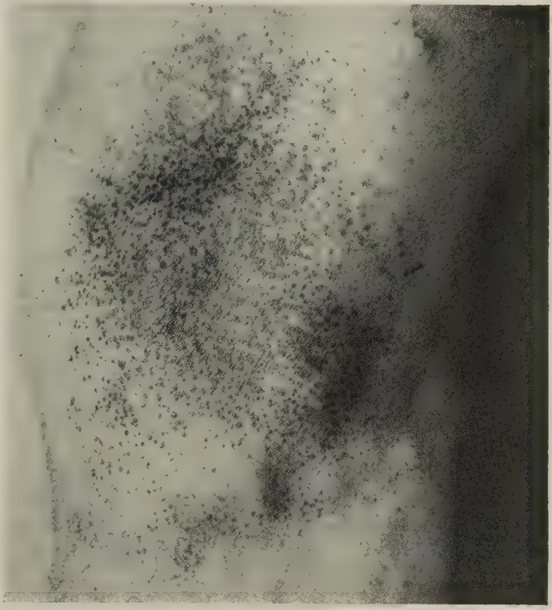

Fig. 311.—Lichen nitidus in the bend of the knee. (Courtesy of Dr. H. W. Barber, London, England.)

The cause of lichen nitidus is unknown. Barber and Civatte believe it is merely a variety of lichen planus. A tuberculous etiology has been ascribed, among other reasons, on account of the microscopical structure of the lesions, but the grounds for such an assumption are not at all convincing. Cases of lichen nitidus have been reported in persons with undoubted tuberculosis but the majority of patients have not displayed such association of the two diseases. Complement fixation tests and guinea-pig inoculations have given negative results. No tubercle bacilli have been demonstrated in tissue sections. Barber finds it difficult to believe that an extensive eruption could be present in a person with no clinical evidence of tuberculosis if the disease were a tuberculide, and points out that it is always possible to obtain definite evidence of tuberculosis by careful general examination in persons with the undoubted tuberculide eruptions, such as lichen scrofulosorum, erythema induratum, and folliclis. However, Zingale, in a review of 46 cases, expresses the opinion that there is a definite relationship to tuberculosis.

Treatment.—No method of treatment has given uniformly good results but several agents have at times been effectual. Sutton states that one case responded to external applications of salicylic acid and resorcin. Howard Fox treated one patient successfully with *x*-rays, and Barber found the internal administration of iodine beneficial. One of my patients who had a widespread eruption was treated by both of these physicians without improvement and also received *x*-rays, ultraviolet rays, and iodine from me without benefit, but finally intravenous injections of gold sodium thiosulphate caused improvement. Robinson, at the Vanderbilt Clinic, also had a case which permanently regressed after injections of this drug. In both cases the histopathology was typical.

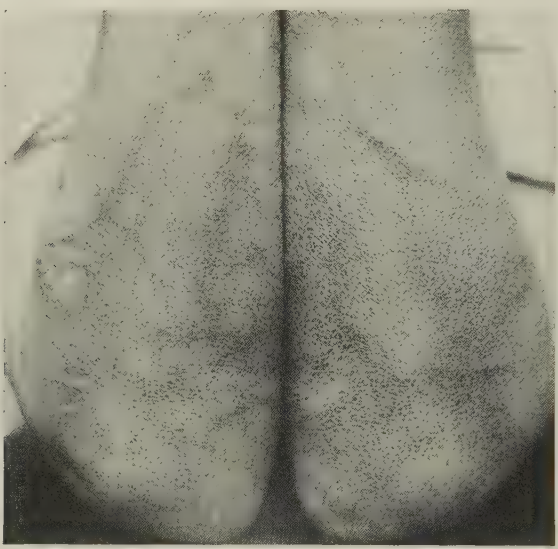

Fig. 312.—Lichen nitidus. Confluent papules forming scaly patches. (Courtesy of Dr. H. W. Barber, London, England.)

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CHAPTER XIX

VESICULAR AND BULLOUS AFFECTIONS

HERPES

Herpes Simplex.—(Fever blister, cold sore, herpes febrilis.)

This affection is characterized by an acute eruption of one or more groups of vesicles, chiefly on the lips. The outbreak is preceded for a few hours by localized itching and during the first day or two of the eruption by a burning sensation. If the contents of a vesicle of herpes simplex, regardless of the location, are inoculated[1] on the scarified cornea of a rabbit, a keratitis is produced, and if transmitted from one animal to another a violent meningo-encephalitis may result. This transmission is regarded as proof that the vesicular fluid contains a living agent, or virus, which is the causative factor. This virus normally lives a saprophytic existence on the mucous membranes, being mildly pathogenic when local conditions are auspicious. The virus probably also causes some cases of herpes zoster by an invasion of the central nervous system, and in a different strain, far more pathogenic, may be the cause of encephalitis lethargica.

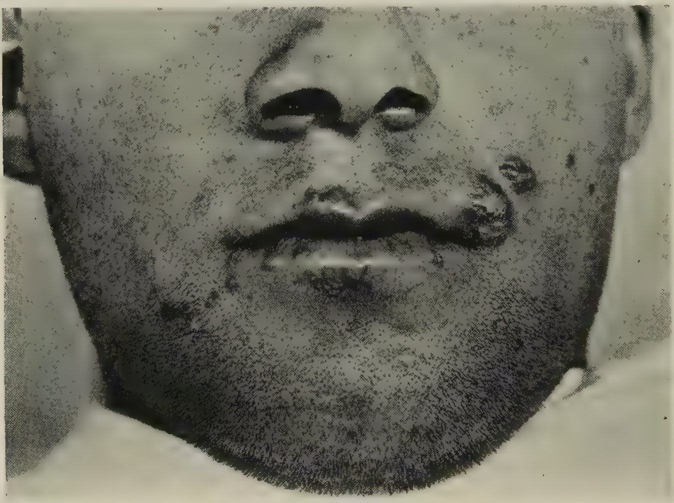

Fig. 313.—Herpes simplex.

Herpes simplex regularly accompanies some febrile diseases such as pneumonia, influenza, malaria, and meningococcus meningitis, but ordinarily is not associated with any constitutional disorder or with such mild disturbances as cold or "upset stomachs." The disorder has a familial tendency in a similar manner to urticaria. Certain individuals seem to have a predisposition to herpes and in them the affection is often recurrent in the same, or approximately the same, situation.

Symptomatology.—The fully developed eruption consists of a cluster of pinhead sized or slightly larger vesicles on a slightly erythematous base. The vesicles at first contain a clear exudate, which later becomes seropurulent. In the course of a few days they rupture and the dried serum forms a flaky crust, beneath which epithelialization occurs. The neighboring lymph glands are sometimes enlarged and tender during the outbreak. Usually herpes runs its course in about a week. After recurrent attacks in the same location there may eventually appear a few telangiectases. On the mucous membranes or in other moist areas, the patches rapidly become sodden.

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[1] Perdrau, J. R.: Herpetic Diseases, Brit. J. Dermat., 39: 1–13, Jan., 1927.

Although the most frequent site for the disorder is on the lips, herpes may appear in any location, the buttocks being a favorite one. The nose is the next common location, both outside and inside, and not infrequently other parts of the face and ears are involved. Rarely the lesions appear within the mouth, on the tongue, or within the pharynx, and they have been described in the larynx and esophagus, in which locations the outbreak is generally accompanied by some constitutional symptoms. The genital region is a common site, the lesions appearing in the male on the prepuce, glans or sulcus and occasionally in the urethra, and in the female, on the labia, mons Veneris, clitoris or cervix. Here the lesions resemble those which appear on the face but have a greater tendency to early rupture and erosion or suppuration. Those persons subject to herpes progenitalis are liable to have successive outbreaks which may follow intercourse, menstruation, or the ingestion of spices, sweets, acid fruits, melons, or alcohol. Where the cause is not elicited, examination of the prostate gland, seminal vesicles, bladder, and kidney or uterine appendages should be made. Any disorder which would lead to chronic congestion of the pelvis or reflex nerve irritation should be eliminated. The lesions tend to heal without scarring except where there has been an unusual amount of suppuration.

Herpes simplex is easy to differentiate from impetigo or herpes zoster. On the genitals the lesions are usually characteristic, but after they have become eroded or contaminated may resemble chancroid, or even chancre. However, the lesions of herpes heal rapidly, while the other processes are slow so that a diagnosis is soon established. In addition, in herpes examinations for the Ducrey bacillus and the Spirochaeta pallida are negative.

Treatment.—For lesions on the face during the eruptive stage the best remedy is a wet dressing of solution of aluminum acetate, but the application of spirit of camphor or a caustic pencil is convenient and effective in mild cases. After these applications, powdered alum may be used. When the lesions are infected, the purulent contents should be removed and an ointment containing 2 per cent ammoniated mercury applied, the same ointment being useful on associated fissures. During the stage of evolution, cold cream containing Burow's solution is beneficial.

On the genitals similar treatment is given except where the lesions occur on apposed surfaces. In this event strict cleanliness is essential. The lesions should be sponged off with peroxide of hydrogen three or four times a day, dried, and dusted with thymol iodide.

Recurrences.—The prevention of recurrences depends upon the discovery of the cause and its avoidance. The history of each attack must be studied in detail and a careful examination made for disturbances which might provoke the eruption. When the lesions have been recurrent on the face, focal infections in the teeth, sinuses, and tonsils must be excluded; the aural canals should be examined for collections of cerumen, the stomach, gastro-intestinal tract, and the diet must be investigated for such peculiarities as contribute to the onset, such facts being discovered more by careful questioning than by physical examination.

In the treatment of recurrences upon the genitals and buttocks, congestion of the reproductive organs from various causes, alcoholism, acidity, calculi in the urinary tract and constipation are the principal factors to be taken into consideration. When the prostate gland is enlarged, massage and hot rectal irrigations should be given. The general health should be improved by regular outdoor exercise and other tonic measures. Vajano reports cases in which ultraviolet rays seemed to have prevented recurrences.

Roentgen Rays.—This form of therapy has been used upon persistently recurring lesions with undoubted benefit. The attacks become gradually less frequent, and during their course the lesions are smaller and involute more rapidly. The dosage should be fractional and always well below an erythema. Either unfiltered or filtered radiation may be employed. *x*-Rays are also used to cause healing of persistent fissures which follow herpes of the lips.

In herpes progenitalis, radicular radiotherapy may be used although the benefits derived from it are dubious. The exposures should be lateral to the midline on both sides of the second, third, and fourth sacral vertebrae and the coccyx, the chief landmarks being the posterior superior iliac spine and the sacral cornu, which are defined on both sides by palpation if the patient lies on his stomach with a cushion under the hips. The area irradiated includes the sacral plexus, the pudendal plexus and their associated sympathetic fibers.

Herpes Zoster.—(Shingles, zoster, zona.)

This affection is characterized by groups of vesicles on an erythematous base situated along the distribution of fibers from one or more posterior ganglia, the onset being rapid, sometimes with fever and neuralgic pain. It may be produced by several agents; the most common is probably an unidentified virus which affects the cells of the posterior root ganglion. Other cases are caused by arsenic or affection of the posterior ganglia in tabes or other diseases of the cerebrospinal system, or their irritation by the pressure of tumors, traumatic injuries or the exudates of systemic diseases such as syphilis. It has been suggested that these conditions are only predisposing causes, for the zoster follows its normal course, heals and does not recur in spite of the continued presence of these factors.

It seems fairly established that a large number of cases of spontaneous zoster are due to the same virus as varicella. Since 1888 when Bokay suggested the possibility of a relationship between the two diseases, numerous instances of their association in the same family have been reported. On account of the lack of an animal susceptible to the varicella virus, the experimental evidence in favor of the identity of the etiologic agents of these two diseases is limited to clinical material. The usual circumstances are that a case of herpes zoster is followed in fourteen to sixteen days by outbreaks of a varicella in associated persons who have not, so far as is known, been otherwise exposed to varicella infection; the patients usually are children, who are the more susceptible. Kundratitz has found that the fluid from the vesicles of a typical zoster eruption, when inoculated into the skin of very young children, produced a local or generalized eruption indistinguishable from varicella. A certain number of cases of concurrent zoster and varicella have been reported, although the bearing of this combination upon the theory of a common cause is open to argument. However, experimental evidence so far available supports the contention that there is at least a dual origin for herpes zoster.

Roxburgh calls attention to the reasons which lead to the opinion that herpes simplex and zoster are different diseases. "Herpes simplex produces no immunity and tends to recur indefinitely, whereas a second attack of zoster is definitely rare (1 per cent, Head and Campbell). An attack of herpes zoster does not protect against herpes simplex. Herpes simplex is not painful, while zoster may be preceded, accompanied, and followed by severe pain. Herpes simplex leaves no scar, while zoster nearly always does, owing to the greater involvement of the corium. Herpes simplex is distributed ap-

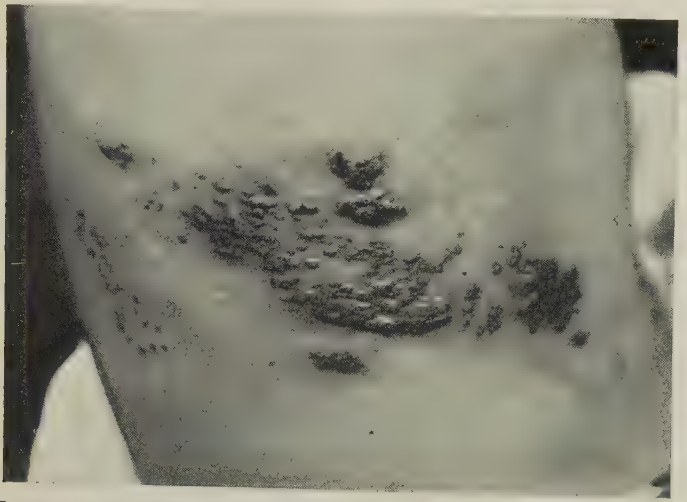

Fig. 314.—Herpes zoster of the lateral abdominal wall. (Courtesy of Dr. Samuel T. Millard.)

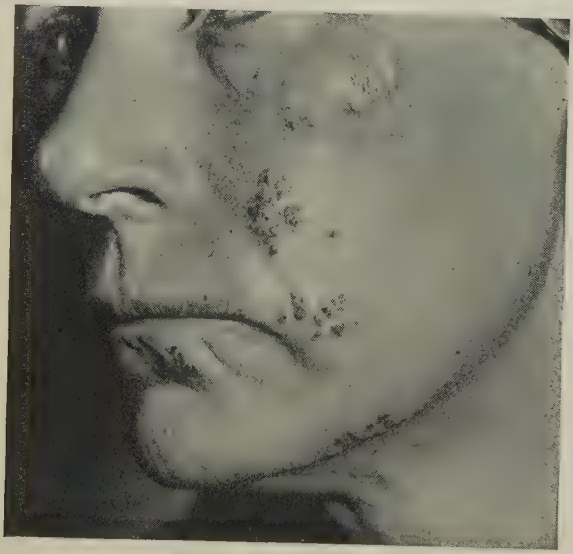

Fig: 315.—Herpes zoster.

parently without regard to nerve supply, whereas zoster always occurs on areas representing the projection on the surface of one or more segments of the central nervous system. Herpes simplex is frequently bilateral, whereas zoster is only rarely so. The virus of herpes simplex is very readily transmissible to rabbits by corneal inoculation; that of zoster is not, although Lipschütz has claimed successes."

Herpes zoster is more prevalent in the spring and autumn than in other seasons, and occurs chiefly in adults. Several epidemics have been reported. The eruption appears in the form of vesicles which are clustered in patches of various sizes, the larger ones being several inches in diameter. Between the groups, the skin is likely to be normal although occasionally the patches become confluent. The vesicles are not very large, being usually the size of B.B. shot, and are surrounded by an inflammatory zone. The early lesions contain a clear serum, but after a few days the contents generally become more or less purulent or the walls rupture and crusts form. Some of the vesicles dry up without these changes, whereas others of a severe type may become hemorrhagic or necrotic, in which case scars may be produced.

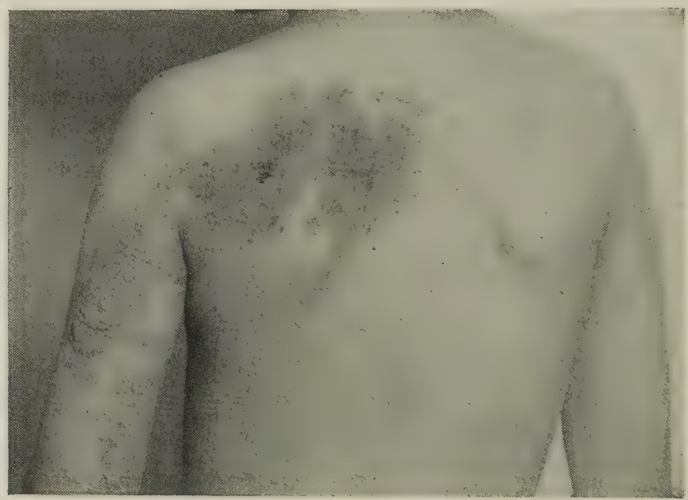

Fig. 316.—Herpes zoster. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

The eruption is usually unilateral, which characteristic is of diagnostic importance. Bilateral involvement and recurrence are uncommon, although in most cases there may be a few lesions on the opposite side of the midline due to transverse nerve twigs.

The onset of the eruption is accompanied or preceded by local itching, tenderness or pain, which may radiate over the entire region supplied by the nerves. Sometimes the lesions appear without any prodromal symptoms but in other cases, in addition to the local symptoms already mentioned, there may be enlargement of the neighboring lymph glands, chills, fever, and malaise.

Attacks vary widely in their intensity but rarely last more than a few weeks. The lesions appear in successive crops but the pain may occur either before the onset, during the presence or after the disappearance of the skin manifestations. It may be entirely absent, or very severe, and in the latter case, in elderly subjects, may last for several months or years.

Certain types of herpes zoster have received descriptive terms the more important of which is herpes zoster frontalis, which is an involvement of the area supplied by the upper branches of the trigeminal nerve. The lesions appear upon the forehead and may involve the eye (herpes zoster ophthalmicus). In such instances, careful frequent examination of the eye should be made. When the nasal branch of the ophthalmic division of the fifth nerve is involved, the eyeball becomes implicated and vesicles appear on the cornea. These change rapidly to ulcers, which may lead to a serious ocular condition. Eye involvement is most common in elderly subjects who have feeble constitutions. Herpes zoster pectoralis, which is the most common type of the disease, occurs over one side of the thorax due to involvement of the intercostal nerves.

Treatment.—The treatment varies according to the site and stage of the disease. Involvement of the cornea is the most serious manifestation of the disease and should be treated by cold compresses of boric acid solution until the patient consults an ophthalmologist. Skin lesions are treated by numerous remedies in all stages, but I have found that talcum powder and a hot-water bag are as good as anything during the onset and later carbolized calamine lotion and carbolic acid ointment. Binding with thick layers of cotton often gives relief. Morphine given hypodermically may be required for pain, but the cold tar analgesics and local anodynes are of little value. When the pain is persistent, relief is often obtained from medical diathermy, a current of 1500 to 2000 ma. for 20 minutes being used twice daily. It is well to place the large electrode over the spine and the small one over the local area. Results are sometimes obtained from a galvanic current of 2 or 3 ma. with the positive electrode over the spine and the negative one applied to the local area. Radicular radiotherapy has also been used with benefit. This technic is described on page 158. Previously irradiated skin is not immune to herpes. Intensive ultraviolet irradiation of the affected skin is credited with giving immediate relief to the pain by Russell and Weinbren.

DERMATITIS HERPETIFORMIS

Synonyms.—Duhring's disease, impetigo herpetiformis, hydroa, herpes gestationis, dermatitis multiformis, herpes pemphigoides, pemphigus circinatus, pemphigus herpetiformis, pemphigus pruriginosus.

This is a comparatively uncommon chronic, relapsing, itching affection which has a tendency toward grouping of erythematous, papulovesicular, vesicular, or bullous lesions or urticarial wheals, which upon involution leave hyperpigmented spots and sometimes scars.

The cause of dermatitis herpetiformis is unknown but it is regarded as a toxic eruption. Focal infections, intestinal putrefaction or fermentation, and nervous excitability are also frequently noted in cases of dermatitis herpetiformis. Pregnancy is a predisposing cause (herpes gestationis, hydroa gravidarum). Generally this type does not disturb the pregnancy, or the health of the child, and terminates after labor, except the pustular cases, which may have a bad outcome.

Symptomatology.—The eruption is usually symmetrical, sites of predilection being the posterior axillary folds, buttocks, abdomen, and forearms. The lesions are acutely inflammatory and often polymorphous, this feature being less characteristic than their distribution and arrangement. The disease runs a protracted course, clears up, and after a few months tends to recur, which process repeats itself over and over.

The manifestations differ widely in various cases, according to the type of lesions and the distribution. Pruriginous papules are a common feature of most eruptions and the edema in some of these is sufficient to produce vesicopapules, which are liable to secondary infection by pyogenic organisms. Mild eruptions may resemble prurigo or urticaria. Vesicular and bullous lesions are usually tense and at first have clear contents, but after a time these become somewhat purulent. Vesicles are more common than bullae; however, all types of these lesions may be present in one case. Factitious urticaria is generally absent.

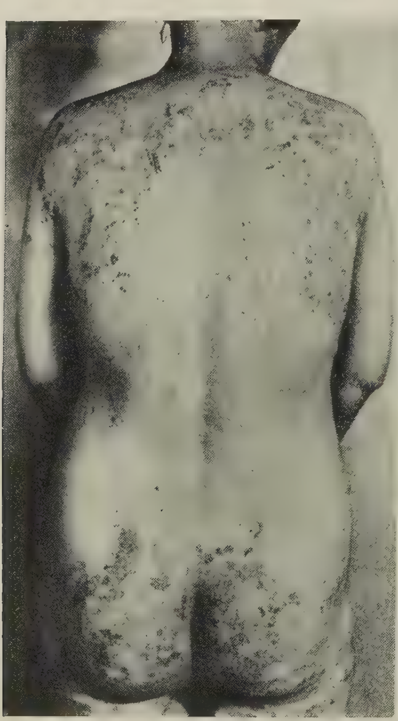

Fig. 317.—Dermatitis herpetiformis, showing characteristic distribution of lesions.

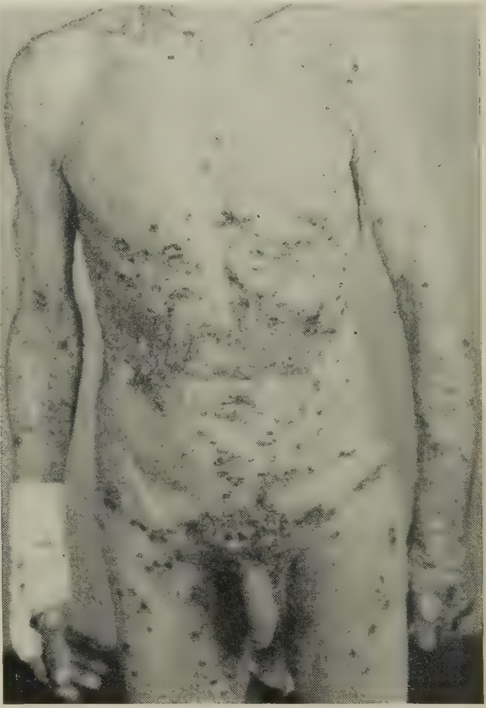

Fig. 318.—Dermatitis herpetiformis. (Courtesy of Drs. J. B. and Bedford Shelmire.)

The tendency to grouping and configuration is a distinctive feature of all the eruptions. Grouping is so regularly present that the diagnosis can scarcely be maintained without it. The clusters may vary in size from a few centimeters in diameter to extensive proportions. At times configuration is marked; circinate lesions occur, as do gyrate patches. The mucous membranes are occasionally involved.

The blood usually shows an eosinophilia which may be as high as 40 per cent. This is a diagnostic feature which is especially valuable, as pointed out by Gardiner, in children, in whom the eruption is less characteristic, lacking the grouping and being more of a generalized vesicopapular type. The affection in children is regarded by some to be a different disease from that which affects adults.

Diagnosis.—The distinction between some types of pemphigus, erythema multiforme, and dermatitis herpetiformis is difficult and it is sometimes impossible to reach a definite conclusion without prolonged observation. Some believe that dermatitis herpetiformis is a mild variety of pemphigus, but this is not the consensus of opinion. Generally there is a polymorphism in the lesions of dermatitis herpetiformis which is not present in pemphigus where the eruption is of a more uniform type. The elementary lesions of dermatitis herpetiformis are, as a rule, papulovesicles, and in any one case there are several phases of development, some being papules, some vesicles, and some pustules. There is also a tendency for the lesions, as previously stated, to be grouped in clusters or configurate patches. On the other hand, in chronic pemphigus the elementary lesion is a bulla and all the lesions are usually bullae. They become much larger than those in dermatitis herpetiformis, which are about the size of a square centimeter. They are distributed without any tendency to order and are apt to involve the mucous membranes, whereas these are usually free in dermatitis herpetiformis. In the latter disease the itching is severe, while in pemphigus the lesions cause little discomfort until they have ruptured, when the raw surfaces are painful. A controversy still exists regarding the relationship of dermatitis herpetiformis and some chronic cases of erythema multiforme, although it is generally assumed that they belong in different categories.

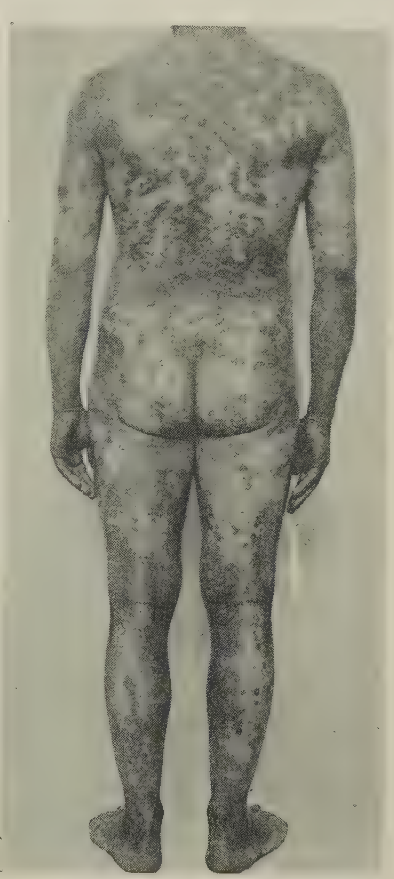

Fig. 319.—Dermatitis herpetiformis. Note intense pigmentation. (Courtesy of Dr. A. Benson Cannon.)

Treatment.—The treatment of dermatitis herpetiformis is principally the elimination of all sources of toxemia and improvement of the general health. The diet should be simple, with such modifications as are indicated by the patient's physical condition. Those who are obese are sometimes improved by reduction of weight, and those who show high blood uric acid are benefited by the elimination of purins and albuminous foods. Constipation should be avoided and elimination increased by the intake of large amounts of fluid, and by an occasional dose of castor oil or a colon irrigation followed by regular use of small amounts of rhubarb or cascara. Every possible source of focal infection should be investigated and eliminated. Stumps of tonsils should be cultured and if there are hemolytic streptococci or tender glands, all tonsillar tissue should be removed. The stool should be examined for ova and parasites. When the blood pressure is low, ephedrine sulphate may be beneficial. Intradermal tests with food and epidermal proteins should be made in all severe cases in the hope of finding some indication of the cause, although I have never had any success with them in this disease. The internal use of arsenic may relieve the itching and control the lesions, but the dangers of prolonged administration must be remembered. It is usually prescribed in the form of liquor potassii arsenitis (Fowler's solution), the Asiatic pill or as arsenous acid. Tryparsamide and neoarsphenamine have been used with benefit. The salicylates may be given either with the arsenic or by themselves, and sometimes seem effectual. Luminal in small doses assists in controlling the nervousness.

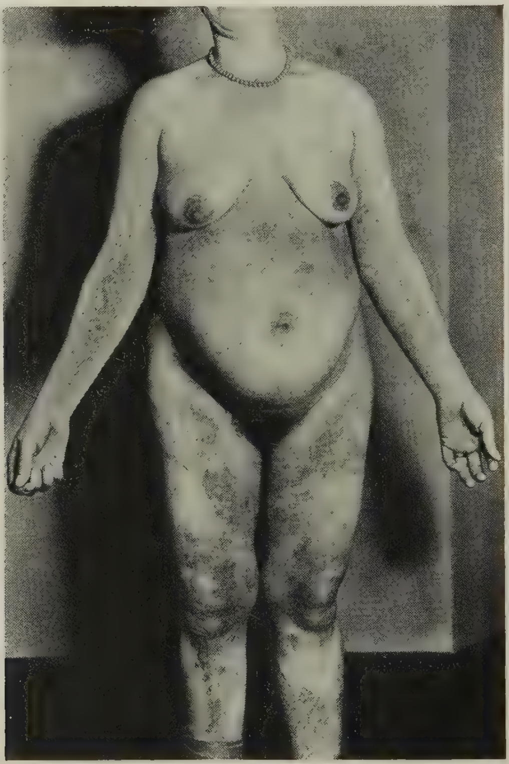

Fig. 320.—Herpes gestationis.

Autoblood injections have been recommended, but have never produced improvement in my cases. Other forms of nonspecific protein, however, have been useful. My best results have been achieved from stool vaccines prepared in the manner described for eczema, in which the skin is tested with the organisms isolated from the stool and a vaccine made of those to which reactions occur. The intravenous use of a combination of strontium, potassium, and sodium bromide has seemed beneficial.

In early mild types, fractional unfiltered x-ray treatment frequently causes the lesions to disappear and the itching to subside for several months. Recurrences which supervene are equally successfully handled by the same therapy. In long-standing cases, especially those of vesicular or bullous character,

x-rays are of no value. Gradual tanning of the skin by generalized exposures to ultraviolet light given three times weekly may diminish the pruritus and slightly lessen the number of lesions. Aside from these influences, physiotherapy is of little aid and resort must be had to local antipruritic remedies consisting of bran, sea salt or potassium permanganate baths, followed by lotions containing phenol, menthol, camphor or liquor carbonis detergens.

Impetigo herpetiformis is an inflammatory condition of the skin characterized by groups of small pustules, associated with constitutional disturbances and sometimes terminating in death. The disease is rare and most of the cases have occurred in pregnant women although cases have been recorded in others, and even in men. A relationship of the disease to dermatitis herpetiformis and to pemphigus is probable, although the exact connection is obscure.

The onset is usually during pregnancy; groups of small pustules appear, each lesion being surrounded by an inflammatory halo. The lesions are usually arranged in circinate patterns or in irregularly shaped clusters and at times coalesce. After a few days the pustules become crusted and dry up, while simultaneously new ones are likely to form about the edges of the patches. By progressive extension several circles may be produced. Generally similar lesions occur on the mucous membranes, where their appearance is modified and they look like superficial grayish erosions.

Systemic symptoms are invariably present and in the course of time become grave. A continuous and intermittent fever of a septic type, chills, vomiting, and diarrhea accompany the disease, and delirium may be present.

The etiology is unknown. If recovery takes place, relapses generally follow. Histologically, the vessels of the cutis are dilated and there is a dense infiltration which consists chiefly of small round cells in the upper strata. The epidermis is acanthotic and within it cocci and other bacteria may be seen, either scattered or in groups. Small abscesses arise and are situated principally in the deeper parts of the rete.

There is no specific treatment; therefore the patient must be cared for according to general medical principles. Antiseptic wet dressings and serum injections from healthy pregnant women are advocated. As those cases which have come to autopsy frequently have shown evidences of nephritis and of septicemia, attention should be given to the renal condition and to the blood. Death results in more than half the cases.

PEMPHIGUS

Pemphigus is a term applied to a group of relapsing, bullous affections sometimes associated with constitutional symptoms. The eruptions have an offensive penetrating odor. The bullae develop from apparently normal skin or mucous membrane and are distributed in an irregular manner. The following types are recognized—pemphigus acutus, pemphigus chronicus, pemphigus foliaceus and pemphigus vegetans. The affections comprehended by the term pemphigus were formerly of greater number because several disease entities have been identified and otherwise classified in recent years.

Etiology.—The occurrence of pemphigus acutus after vaccination and in those who handle animal products suggests that this group of cases is caused by bacterial infection. The course of chronic pemphigus points to an infection. Not infrequently organisms have been removed from all types of the disease but definite causal relationship of any one of them has never been proved. The more important ones reported are a diplococcus (Pernet and Bullock; Demme); a short motile bacillus (Hendry); Bacillus pyocyaneus (Petges, Bichelonne, and several others); coccoid bacillus (Eberson); and a bacillus which produced somewhat characteristic lesions in a monkey (Radaeli, Meyers). In pemphigus vegetans, pyogenic staphylococcci and streptococci, colon bacilli and B. pyocyaneus have been recovered frequently, probably being contaminants.

Other theories regarding the cause of pemphigus are that it is of toxic or neuropathic origin. The latter contention is supported by its frequent association with nervous exhaustion. Covey, McGlasson and Keiller, and

Strickler and Brown have substantiated this theory by the finding of pathologic changes in the spinal cord and spinal fluid.

Diagnosis.—Pemphigus must be differentiated from dermatitis herpetiformis, erythema multiforme bullosum, and dermatitis medicamentosa. The lesions in dermatitis herpetiformis are usually combinations of papules and vesicles, whereas those in pemphigus are solely large bullae. Of course, large bullae can occur in dermatitis herpetiformis but in the latter disease the bullae are likely to be smaller and associated with papules or vesicles. Itching is generally absent from pemphigus and is intense in dermatitis herpetiformis, and in the latter disease there is a distinct tendency to grouping and for the bases of the lesions to be inflammatory. In pemphigus the lesions appear in crops upon normal skin and, when broken, leave large raw oozing surfaces on which the exudate dries to form thick crusts, beneath which a purulent fluid collects. Erythema multiforme bullosum is localized to one part of the body, usually the upper extremities, whereas pemphigus affects any area, with a predilection for the face, mouth, and anogenital region; while the eruption in dermatitis herpetiformis may be generalized, but favors the axillae, shoulders, and buttocks. Drug eruptions may closely resemble pemphigus. Their lesions, however, as a rule appear on inflammatory bases and the history of the taking of the drug is easily elicited, for drugs only produce such severe symptoms if taken in large amounts. Drugs which cause bullous lesions are innumerable but those which often cause eruptions that have a semblance to pemphigus are luminal, phenolphthalein, chloral hydrate, and the bromides. Pemphigus does not occur in children, so that age differentiates it from pemphigus neonatorum (impetigo), and the bullous eruption of congenital syphilis.

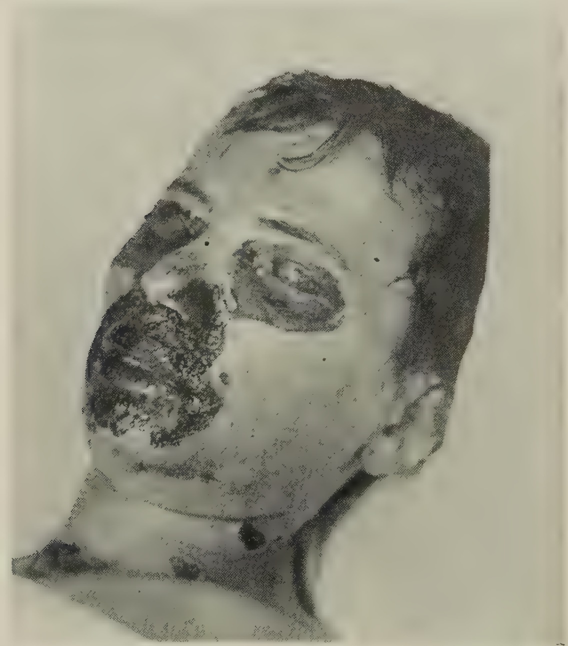

Fig. 321.—Pemphigus acutus. (Courtesy of Dr. J. Gardner Hopkins.)

Pels and Macht have made an investigation of a toxic index of the blood serum from a number of patients with dermatoses of unknown and of presumably known origin by the phytopharmacological methods developed by Macht. This method is based upon plant physiologic tests—certain abnormal products in the blood of patients suffering from certain diseases, such as pernicious anemia, have a more poisonous effect upon living plant protoplasm than normal blood. Over 230 specimens of blood derived from a variety of dermatological cases were tested by contact with the seedlings of Lupinus albus. The seedlings were germinated and grown under definite physical conditions, and their growth was studied quantitatively by measuring the elongation of the roots and other changes. Most dermatological conditions did not show any influence upon plant protoplasm but the blood from patients with pemphigus gave a strikingly low phytotoxic index, which was characteristic of that disease, indicating a definite toxicity as compared with normal blood. The observation of a toxic factor in the serum in various types of pemphigus may prove of value in differential diagnosis.

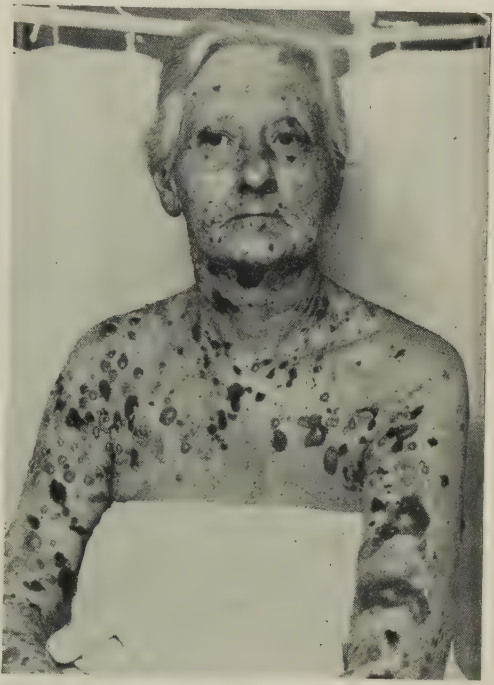

Fig. 322.—Pemphigus. (Courtesy of Dr. Edward A. Oliver.)

Treatment.—This may be divided into internal and external measures, most reliance being placed upon the former. The diet should be nutritious and high in vitamin content. Cod liver oil, yeast and tonics containing iron, quinine, strychnine or arsenic should be given. These drugs have at times given splendid results, although none of them can be regularly relied upon and each must be tried, one after the other, until improvement is obtained. The best results are achieved by hypodermic or intravenous injections of the drug in addition to mouth medication. Sodium arsenite has been injected hypodermically in accordance with the formula mentioned for the treatment of lichen planus. Neoarsphenamine has been a valuable remedy in the hands of several authors. Davis used a cacodylate of iron with considerable success. Leszczynski and others have reported good results from the intravenous use of quinine. A solution of 1 per cent mercurochrome–220 soluble has been used in doses of 10 cc. intravenously and has occasionally given good results, but it should be cautiously administered, as some reactions are severe. Injections of horse serum or coagulin to increase the coagubility of the blood have a beneficial action.

Local measures include the drainage of large bullae by aspiration with a syringe and a twenty-gauge needle. Oily applications—carron oil; albolene; or ichthyol, 5 per cent in olive oil—are applied to the whole surface. On large raw surfaces the tannic acid treatment described for burns is valuable.

Pemphigus Acutus.—(Pemphigus malignus, febrile pemphigus, blister fever.)

This acute type is rare and is accompanied by severe constitutional symptoms, usually terminating fatally. The disease is known to be caused by some virulent micro-organism derived from living or dead animals, the infection generally occurring in butchers, on the fingers, or after vaccination. The onset is sudden, the only prodromal symptoms being an infected wound of the fingers. The bullous eruption appears first on the fingers or in the mouth or about the neck and spreads rapidly, so that large surfaces are involved, followed by successive crops, which appear suddenly. The bullae range in diameter from one to several centimeters, usually being about the size of an English walnut. They are at first tense and contain a clear serum, but quickly rupture, leaving raw surfaces. Extensive surfaces as a rule become denuded by coalescence of the lesions and this leads to much suffering. Hemorrhagic lesions occur in severe cases and there is often a purulent exudate on the denuded surfaces which produces a fetid odor that is more or less characteristic. Lesions occur on the conjunctiva, within the mouth and on the mucosa of the throat, trachea, and in the gastro-intestinal tract. The disease runs its course in a few weeks and terminates in death through exhaustion. Occasionally there is recovery and some cases are recorded in which the acute type has merged into chronic pemphigus.

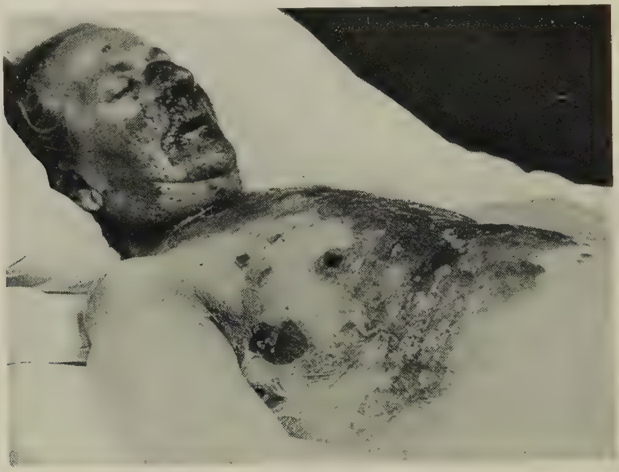

Fig. 323.—Pemphigus. (Courtesy of Dr. A. Benson Cannon.)

Treatment.—Prophylaxis is an important part of treatment of this type of pemphigus, for it can be prevented by timely treatment of wounds in butchers and others working with animal products. After the disease has developed, the treatment is largely symptomatic, special attention being given to the gastro-intestinal tract, to nutrition and to the action of the heart. Tryparsamide and large doses of alkalies or quinine have been recommended. Cultures should be made in an attempt to isolate an organism from which a vaccine might be made. Local emollients and mild antiseptics are best, preference being given to the oily preparations mentioned later.

Chronic Pemphigus.—(Pemphigus vulgaris, true pemphigus.)

The chronic type of pemphigus is a more common variety of the disease, It usually occurs in debilitated patients who are past middle age. The bullous lesions develop on any part of the body, frequently occurring about the face, mouth, neck or genitals, or, instead of being of a limited extent, they may be generalized. The lesions appear in crops and there may be long periods of comparative freedom from the affection. Some of the lesions are tense and others are flaccid. The contents vary according to the stage of development, being at first clear and later hemorrhagic or seropurulent. Not infrequently there is a tendency to grouping or ring formation. Usually the bullae rupture and the raw surfaces become covered with crusts or show no tendency to heal, spreading to extensive proportions by confluence. Those lesions which heal may leave hyperpigmented scars.

The outcome of pemphigus vulgaris is usually fatal although some mild cases may continue indefinitely (pemphigus benignus) or may be free from any sign of the disease for such a long period that they are considered cured. On the other hand, the disease may be rapidly progressive causing death in the course of a few months. When the lesions occur in the mouth or throat the prognosis is bad, because the mere presence of tender lesions in these sites makes it difficult to maintain nutrition. In severe cases there is little tendency for the lesions to heal. Constitutional symptoms vary.

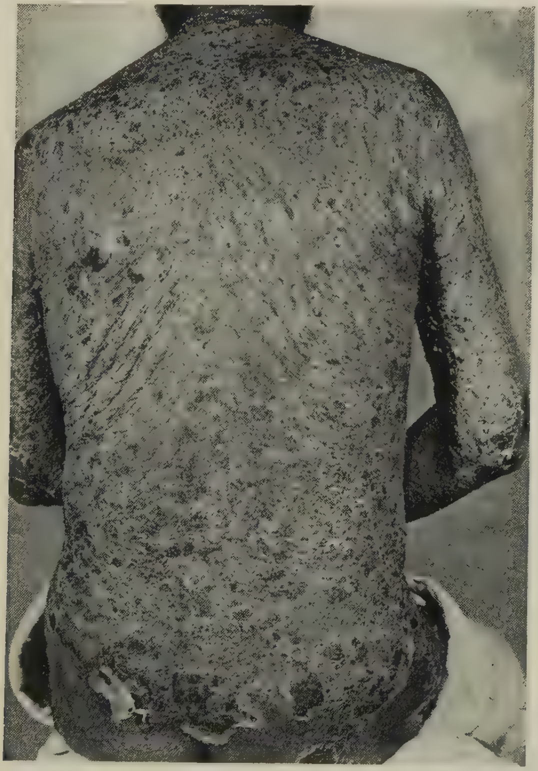

Fig. 324.—Pemphigus foliaceus. (Courtesy of Dr. A. Benson Cannon.)

Hollander has reported good results from blood transfusions given in amounts of 200 to 400 cc. Five cases of the six treated showed marked improvement in general and in the skin conditions; in the sixth case while there was marked improvement in the skin condition, death occurred from an intercurrent acute infection.

Pemphigus Foliaceus.—This affection is a rare and grave type of the disease characterized by imperfectly formed flaccid bullae and generalized exfoliation. Nikolsky's sign is present, that is, there is an absence of cohesion in the skin, so that the upper layers of the epidermis are easily removed by slight pressure or trauma. The sign is variously elicited. By pinching the skin one removes the epidermis, leaving a raw surface, or by digging with the nail one easily scrapes off the epidermis. The test is not specific. The disease usually occurs in young adults, being superimposed upon chronic pemphigus or beginning with a nondescript vesicular dermatitis spreading symmetrically until the entire integument is involved with a moist, red, edematous, exfoliative, malodorous condition. As in chronic pemphigus, there are temporary remissions followed by new attacks. After a time the exfoliative characteristics predominate, bullous lesions becoming less common. The conjunctivae and mucosae may be involved; as a rule the latter not so severely, but the nutrition is surprisingly well maintained. It may occur on the scalp, causing the hair to become scanty and covering it with moist yellowish granular scales. The face and the rest of the body may also be affected. A rise in temperature and diarrhea may ensue, but death usually comes from some intercurrent disease such as bronchopneumonia or cardiorenal failure.

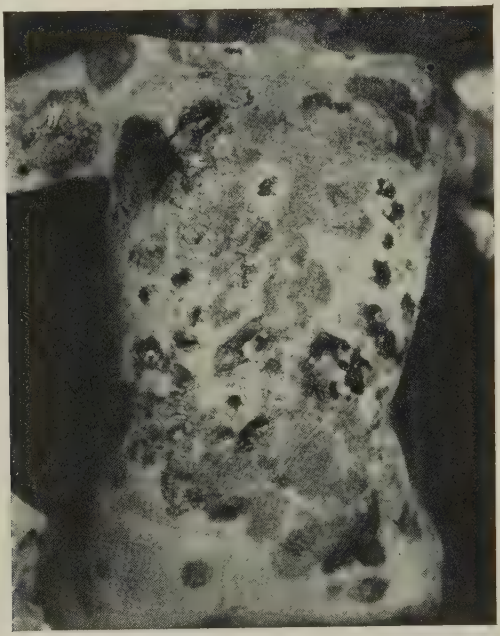

Fig. 325.—Pemphigus vegetans. (Courtesy of Drs. George W. Covey and Edward J. Angle.)

Pemphigus foliaceus must be differentiated from generalized exfoliative dermatitis, which is a dry condition, whereas in the former there are flaccid or imperfect bullae, with moist raw surfaces and a distinctive odor, or the history of such lesions. From chronic pemphigus and dermatitis herpetiformis, pemphigus foliaceus is differentiated by the imperfect character of the bullae, by the exfoliation and by symmetrical extension until the involvement is universal, a feature not seen in the other two diseases. Generalized eczema is never universal and is not accompanied by flaccid bullae and the peculiar odor.

Treatment is largely symptomatic. The odor is controlled by baths with potassium permanganate solution, followed by emollients of an oily character, or by a water-bed. Internally arsenic and other tonics, and a liberal diet may assist in maintaining the nutrition.

Pemphigus Vegetans.—(Dermatitis vegetans.)

This is a rare type of pemphigus which is characterized by fungoid vegetations. Although the onset of the disorder may be manifested solely by broken bullae in the mouth or about the genitals or umbilicus, the imperfect bullae rupture and their moist bases become exuberant with vegetations that later form the principal feature of the eruption, being capped by crusts and surrounded by a zone of inflammation. At times there is a tendency for the lesions to coalesce to form large patches or arrange themselves into groups or configurate patterns.

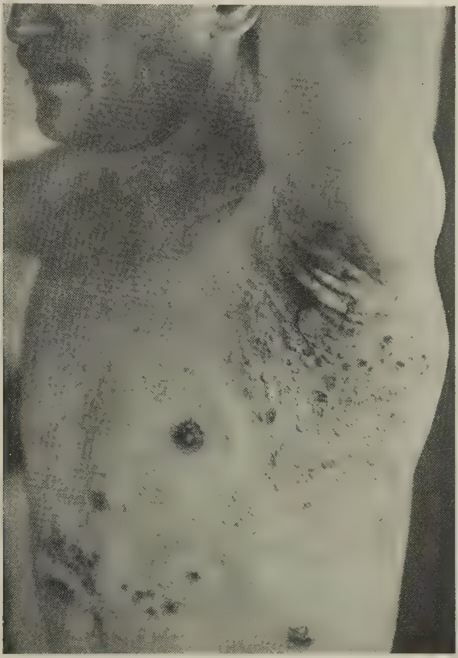

Fig. 326.—Pemphigus vegetans. (Courtesy of Dr. A. Benson Cannon.)

Pemphigus vegetans begins insidiously, usually on the nose or in the mouth. Other areas frequently affected are the axillae and groins, genitalia and perineum, the extremities, and scalp. The subjective symptoms are slight and there are often long remissions in the course of the disease. At times, however, high fever and other constitutional symptoms develop due to sepsis, and the termination is generally from an intercurrent disease, to which there is a predisposition on account of exhaustion.

Pemphigus vegetans must be differentiated from the fungating iodide eruption. The latter occurs without regard to sites of predilection and is not accompanied by the systemic disturbances and other characteristics of pemphigus. Syphilitic condylomata may resemble the lesions but are excluded by the finding of bullae, or the diagnosis of syphilis may be established by positive darkfield examination, or by a positive Wassermann test.

Treatment.—Treatment consists of supportive measures, principally the administration of arsenic, iron, and quinine together with a nutritious diet high in vitamin content. Neoarsphenamine or tryparsamide may be given intravenously and good results have occasionally been obtained from the intravenous use of 1 per cent solution of mercurochrome–220, given in doses of 20 to 30 cc., but, as stated, it is attended by violent reactions.

Injections of horse serum or thromboplastin are sometimes beneficial. Malten and Thedering recommended generalized ultraviolet therapy in addition to these other remedies, on account of its tonic action. Fuhs reported 5 cases treated by radium and *x*-rays, in which some benefit had apparently been obtained by these agents. A slight temporary relief may be afforded by *x*-rays, but benefit from them in my experience has not offset the inconvenience and discomfort to the patient necessary for their application.

The outstanding remedies at present are arsenic, transfusion, and injections of foreign proteins, of which the foremost is thromboplastin (coagulin—Ciba). Cannon has had better results from thorough alkalinization than from any other kind of medication.

The skin lesions should be treated by moist dressings; acriflavine solution, 1 : 1000 in normal saline, being useful to deter secondary infection by pyogenic organisms; or a cold cream made of 5 per cent solution aluminum acetate (Burow's solution) may be applied. Diachylon ointment or naftalan, 10 per cent in zinc oxide ointment, is a soothing remedy.

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CHAPTER XX

ACNE VULGARIS

Synonyms.—Acne adolescentium, acne.

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous follicles characterized by comedones, papules, pustules, cysts, and nodules. The most common sites of predilection are the cheeks, although it frequently attacks other parts of the face or the back, chest, and upper arms. It is one of the commonest and most polymorphous of skin eruptions, usually manifesting itself at the age of puberty in those who have coarse, oily, plethoric skins, due to a combination of oily seborrhea of the face and pityriasis of the scalp. The commonest lesions are blackheads (comedones) and papules. The latter are formed by inflammation about blackheads, and as a result are acuminate, often topped with a blackhead. According to the degree and nearness to the surface of the inflammatory reaction, the color of the papule varies from bright red to deeper and fainter shades. Frequently these papules are transformed into pustules, which may be pointed or rounded, and contain yellowish or white pus. In severe cases nodules and deep granulomatous infiltrations, cysts, scars, and keloids are encountered. These types of the disease are discussed separately under the subject of treatment.

Etiology.—The affection is due to changes in the consistency of the sebaceous secretion, leading to the formation of comedones and their subsequent infection. It is most frequent between the ages of twelve and thirty, but usually is worse at puberty and adolescence, when all the glands of the body are hyperactive. The increased activity of the endocrine system—gonads, thyroid, and other glands—affects the secretions of the sebaceous glands. This relation is also manifested during menstruation, preceding and following which time the eruption is likely to be aggravated. Both the quality and quantity of the sebum may be affected.

The sebum produced is so concentrated or profuse that it does not entirely gain access to the surface. It gradually accumulates within the follicular orifices, together with increased numbers of stratum corneum cells from exfoliated follicular epithelium, so that cheesy plugs eventually form, which block the openings. The external end of the plug becomes dry and discolored from dirt and oxidation, and is called a blackhead. This foreign particle presses upon adjacent cells and interferes with their nutrition and resistance to infection in a manner similar to any other foreign body.

After reaching this stage, the element of infection may at any time supervene. Within the blackhead acne bacilli are invariably found and these may alter the character of the oily secretion. According to Unna and others, they may even be the cause of the formation of the comedo. Usually there is also an admixture of staphylococci. As the resistance of the perifollicular cells is lowered by the foreign substance, these micro-organisms, alone or in combination, produce papulation and pustulation with the formation of follicular abscesses, indurations, or nodules.

In the majority of instances acne is a local skin disease, but its course is influenced by the internal secretions, general health, and diet. Toxic states

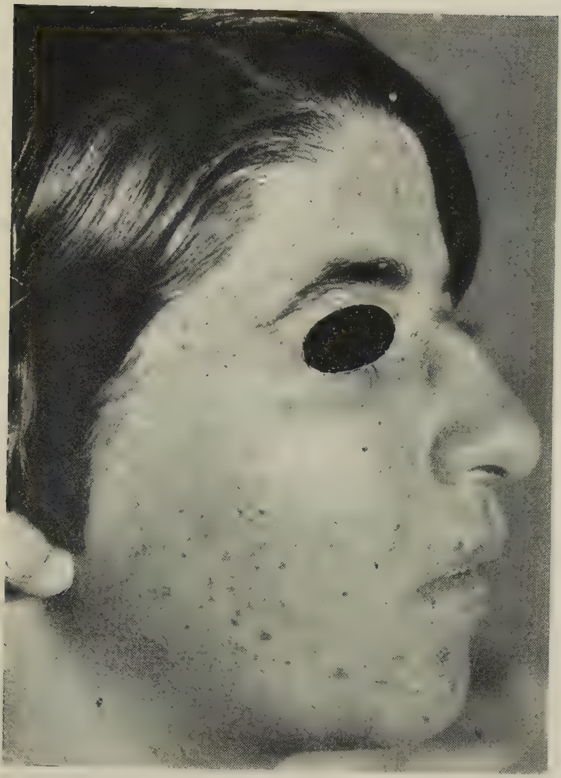

Fig. 327.—Acne vulgaris, comedo type.

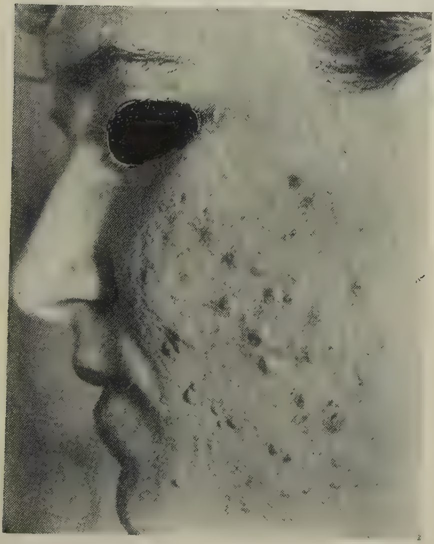

Fig. 328.

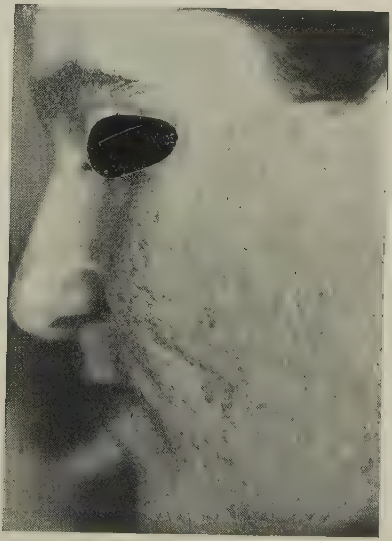

Fig. 329.

Figs. 328, 329.—Acne vulgaris, papular type. Before and after x-ray treatment.

due to constipation focal infection, or hyperacidity aggravate the disease, as does also excess of carbohydrates derived from sweets, starchy foods, fats, or overeating.

Treatment.—In order to obtain the desired result in the treatment of acne vulgaris and to accomplish this end without injury, one must have a broad knowledge of the etiology and management of the disease, as well as of the biological effects of roentgen rays. The type of acne, the patient's age and general health, variations in susceptibility to x-rays, and local remedies, the predisposing cause, location on the cutaneous surface, contour of the face, texture of the skin, presence of more or less pigment, and inaccuracies of the best roentgen-ray technic are all factors to be taken into consideration. Each case must be carefully studied before treatment is instituted.

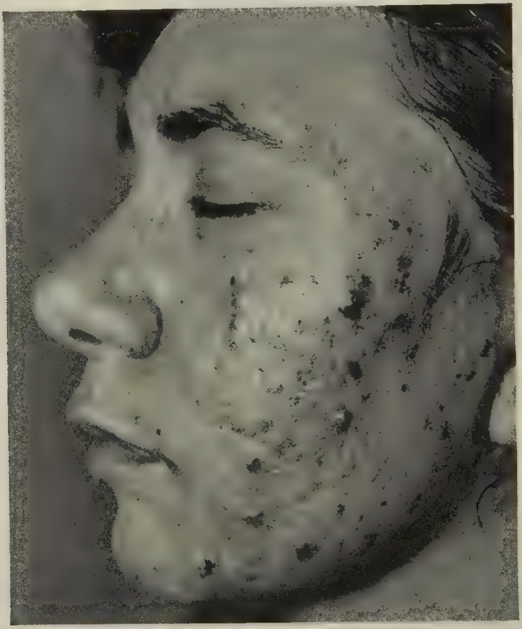

Fig. 330.—Acne vulgaris. Note oily seborrhea, scars, and pustules.

The treatment naturally divides itself into local and constitutional. In a few cases where the lesions are limited and the general health unimpaired, local treatment is all that is required, but in the vast majority of cases some form of general treatment or régime is of assistance.

1. *Local Treatment.*—Numerous forms of local therapy have specific indications in the treatment of acne, but radiation is the one which produces the most rapid and permanent results. Although useful in a variety of clinical types of the disease, radiation is best employed only *in selected cases as an adjunct to other dermatological remedies such as surgical procedures, lotions and ointments, which are described later.* Unfiltered and filtered roentgen rays are the most common form of irradiation employed, filtered exposures being particularly indicated in indurated cases, and in addition, ultraviolet light is useful in superficial acutely inflammatory eruptions where there are no notable comedones.

(*a*) *Roentgen Rays.—The Selection of Cases for Roentgen Therapy.*—Although at the Vanderbilt Clinic we use *x*-rays in about 80 per cent of the cases of acne, there are certain cases in which they should not be employed, and others in which they are specifically indicated. In all *mild cases* it is advisable to attempt the cure by other methods, such as local and constitutional remedies and hygienic measures. If the lesions fail to involute within a reasonable length of time, roentgenization should then be instituted. In *acutely inflamed eruptions* roentgen therapy should be deferred until the symptoms have subsided. When in addition the lesions are superficial, ultraviolet light may be used with great benefit until such time as roentgen therapy can be begun. *x*-Rays should not be used in *infantile acne*. In *toxic cases* roentgen rays are of little value unless the toxic condition is eliminated before or while the acne is being treated. In *recalcitrant cases*, especially in the so-called "seborrheic" or "menstrual" acne, if the lesions persist for three or four months in spite of fractional *x*-ray treatment, it is advisable to resort to some other form of therapy. In *recurrent cases*, after previous roentgen therapy, further radiation is permissible only under conditions which are stated later.

x-Ray treatment is specially indicated when comedones are numerous, large or hard, or the intervening skin is thickened. Also when there are deep-seated destructive lesions or hypertrophic scarring, methods other than x-rays are so unavailing that roentgen therapy is indicated from the beginning. In all indolent cases accompanied by oily seborrhea of the affected areas, excellent results follow x-ray therapy.

Dosage.—The best results are always obtained by the use of fractional roentgen radiation. The classical dosage of unfiltered *x*-rays is $\frac{1}{4}$ E. D. given weekly to the affected areas, with the eyes, eyebrows, scalp, hair, ears, and thyroid shielded. With filtered radiation one sixth of an erythema exposure is similarly employed. Only exceptionally, in badly indurated cases, does filtration seem an advantage. The radiation is usually unfiltered or lightly filtered, although a filtration of 3 mm. of aluminum is routine in some clinics. As a general rule, it is advisable to use as small a dosage as possible to effect involution. Most patients will tolerate fractional treatment consisting of one fourth unfiltered erythema dose applied once weekly to the affected areas over a period of two or three months without the slightest deleterious action. A course of six to eight treatments will suffice in many instances, but in recalcitrant cases, in the absence of erythema, wrinkling or excessive dryness of the skin, it is permissible to continue the radiation to a maximum of fourteen to sixteen treatments.[1] The number of exposures to be used upon a case of acne is governed by the sum total of the doses of each exposure and by the clinical changes in the skin which appear during the course of treatment. The dosage of all exposures collectively should not exceed 3½ E. D. distributed throughout one year. In most cases it is inadvisable to give a sum total dose of over 2½ E. D. The operator cannot be guided solely by such measurements, but must carefully study the biological response of the skin to the exposures.

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[1] In Europe, Sequiera uses an exposure of roentgen rays equivalent to one third Sabouraud pastille dose at intervals of three weeks. This has proved of value in many cases. Attention is directed at the same time to general treatment. MacLeod employs a full Sabouraud pastille dose to produce temporary atrophy of the pilosebaceous follicles. Thedering applies one third H E D filtered through 0.05 mm. aluminum at ten-day intervals, making a total of three exposures, after which there is a rest of three weeks before the radiation is repeated. He peels the skin with quartz light therapy before applying the *x*-rays. Such treatment attains a cure in about ten weeks. Dórcz employs an unfiltered dose of fifteen F at ten-day intervals amounting to a total of three or four treatments. Further irradiation is frequently given after an interval of six to fourteen weeks. Sabouraud uses four roentgen applications at eight-day intervals of half-tint Sabouraud-Noiré, each of approximately 400 R by the ionometer of Solomon, with the rays marking 10 inches by the radiochronometer of Benoit, filtered by a millimeter of aluminum. The whole treatment is completed within a month. He emphasizes that recurrences may be expected as long as the causal factor of the acne, namely, the seborrhea, is not cured and employs sulphur for this purpose. Sabouraud has not met with any recurrences under this treatment.

Such clinical changes are of great importance in determining when the dosage should be increased, moderated or stopped. They should be constantly kept in mind. Improvement usually first manifests itself by inhibition of the secretions of the sebaceous and sweat glands, causing a diminution in the amount of oil on the skin, frequently followed by a decrease in the number of new lesions. Whenever these two clinical features are present they indicate that the skin has received about as much irradiation as it will tolerate.

At the first indication of these changes it is advisable to desist the x-ray treatment for a period of two or three weeks and to proceed carefully thereafter with infrequent smaller doses. Epilation and erythema are always evidences of excessive treatment and must be avoided, as they are almost invariably followed by atrophy or telangiectasis. Prior to each exposure the skin should be carefully examined to determine whether such reactions are present before proceeding with the treatment. Irritability of the skin in response to slapping or stroking, or rapid profuse hyperemia due to the application of hot towels indicates that the margin of caution has been exceeded and that further treatment without a rest interval of three or four weeks will produce an erythema. Freckles and tanning are not reliable indications for the number of treatments to be given, the approximation of improvement or of an erythema. In some delicate skins, freckles or pigmentation follow one subfractional exposure, and in other skins these manifestations do not appear until immediately preceding an erythema or subsequent to it. Pigmentation *per se* is not considered injurious or a contraindication to further roentgen

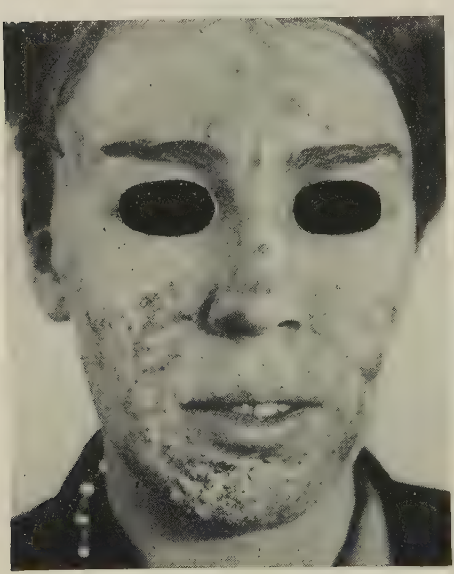

Fig. 331.—Pustular and indurated type of acne vulgaris.

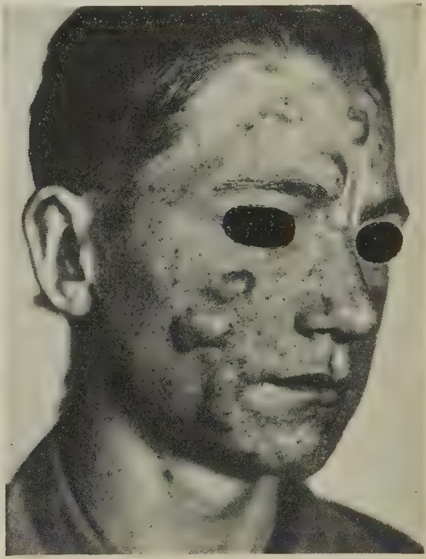

Fig. 332.—Cystic type of acne vulgaris.

treatment. Wrinkling should be avoided. It is a sign of excessive dosage and is always preceded by dryness. Therefore we must conclude that manifestations of cutaneous changes, especially of an inhibitory action upon the sweat and sebaceous glands, guide the judgment concerning the number of exposures in the same manner as the response of the heart to digitalis governs the dosage of the drug.

Variations in individual susceptibility are due, for the most part, to age, texture of the skin, complexion, and the part of the body affected. In middle-aged or older individuals, the skin will tolerate more radiation, and dryness or tendency to wrinkling caused by *x*-rays is more apt to be temporary and of less significance than in younger individuals. In thin, scrawny patients, who have little subcutaneous tissue, dryness will lead to more wrinkling than in fleshy patients, and for this reason the dosage should be most cautiously administered in the former type of individual. Low toleration exists in young blondes with delicate skins, especially females and in those who have a tendency to transient hyperemias (flushing), or more permanent hyperemias (plethoric complexions, acne rosacea, acne pustulosa, acne erythematosa). In these instances, caution should be exercised and subfractional treatment ($\frac{1}{8}$ E. D. once weekly) is indicated. In brunettes, especially males, with coarse oily skins, it is permissible, in selected cases, to administer $\frac{1}{2}$ E. D. every two weeks, or $\frac{3}{4}$ E. D. every three or four weeks, especially when the patient lives at a distance, or for any reason finds it inconvenient to make weekly visits. When such treatment is applied, careful shielding is urged. Such large doses are inadvisable upon the face, but may be applied to the back, arms, and chest.

Of the locations on the cutaneous surface which influence the dosage, the face is more susceptible to radiation than the back, chest, or upper arms. On the face the most sensitive regions are about the angles of the mouth and the centers of the cheeks. Next in sensitiveness is the chin. The angles of the jaws and forehead are least sensitive.

Technic.—Before each x-ray treatment the parts should be cleansed with soap and water and alcohol, and the physician should carefully remove the comedones, evacuate the pustules, and give any other surgical treatment that may be indicated.

When the *face* is involved it is customary to make two exposures at each sitting. In general, it is well to focus over the most diseased areas without too much overlapping. However, this usually means focusing over the outer end of the zygoma for each exposure. The patient is placed in the recumbent position so that the plane of the irradiated surface is at a right angle with a perpendicular constructed from the anode to the skin. This method permits the radiation to spread over each side of the face, and the oblique rays from the two exposures overlap upon the forehead, nose, and chin so that there is approximately equal distribution over the entire face. In those whose faces are angular the distribution of equivalent amounts of radiation over the affected areas can often be accomplished only by changes in the technic, either by lengthening the anode-skin distance or by changing the focus points from the malar regions to the angles of the jaws, and giving a supplementary exposure of $\frac{1}{8}$ E. D. to the chin or the center of the forehead. Thus three exposures are given, the additional one being to the mid-face and in a direction at right angles to the lateral exposures. Such changes in the technic should be used with caution, and only by those who have had considerable experience in the roentgen treatment of the disease. The dosage of the additional exposure will be governed by the amount administered in the lateral exposures. When the disease is pronounced on the cheeks the usual dose is $\frac{1}{4}$ E. D. to each cheek, to which an additional $\frac{1}{8}$ E. D. is given to the mid-face every alternate week. Where the affection is principally upon the mid-face, the dosage may be $\frac{1}{4}$ E. D. weekly to the center of the face and $\frac{1}{8}$ E. D. to each zygoma weekly or every alternate week. It is inaccurate and dangerous to allow overlapping of the face exposures on the upper chest in order to treat acne of the latter area. The chest should always be protected from exposures on the face.

When the *chest* is affected, it should be separately treated with proper shielding of the face. If the eruption is limited to the center of the chest, one exposure with the anode over the sternum will suffice, but if the eruption is distributed over the anterior surfaces of the shoulders two exposures are necessary. The anode is placed midway between the nipples and the anterior axillary lines. The oblique rays overlap at the center of the chest. When the anterior surfaces of the upper arms are affected, they are exposed to these treatments by being placed along side of the thorax on a level with the anterior surface of the chest. Occasionally the external surfaces of the upper *arms* are severely involved, and it is necessary to give them separate exposures. When the upper *back* is affected, two exposures are given with the anode focused over the posterior axillary folds, or slightly mesial to them when the patient has a broad back, the scalp being shielded with lead-foil. Additional exposures may be given to the midline or sides of the lower back when the eruption is distributed on this area; but the greater the number of areas treated, the greater is the caution to be observed to prevent excessive overlapping. In widespread cases involving the face, upper chest, and back, overlapping is likely to cause telangiectasis on the upper sternal region from careless shielding of the face from the chest, or telangiectasis on the upper middle back from excessive overlapping of the scapular exposures. The latter possibility is enhanced when exposures are also made to the lower back.

General Comment.—The first few exposures of x-rays at times cause aggravation of the disease, the radiation seeming to irritate the skin. As an illustration, in some cases of papular acne associated with numerous large comedones, the lesions suddenly increase in size and number following the institution of x-ray treatment. Occasionally, similar augmentation is noted in acutely inflammatory forms of acne vulgaris. It is wise to desist further x-ray treatment upon the occurrence of such symptoms for a period of two or three weeks, until the aggravation has subsided and then to continue the roentgen treatment with subfractional doses. After roentgen therapy, in rare instances, there remain some excessive oiliness, a few comedones, or a coarse skin due to large follicular orifices. It is usually advisable that these be treated by the local measures described in the paragraphs on topical remedies on page 501 rather than by further radiation.

Although it is the goal of the physician to obtain a permanent cure, and this is possible in practically all cases, undertreatment and caution may make a certain number of *recurrences* necessary. Between 10 and 20 per cent of the cases of acne vulgaris require small amounts of radiation one to two years after the first course of treatment. It is usually sufficient to limit this radiation to one or two small areas upon the forehead, behind the ears, or on the sides of the neck, and in such instances, generally no more than three or four fractional treatments are required to clear up the remaining lesions and complete the cure. When cases are incompletely cured by x-ray treatment or have had recurrences after radiation, it is sometimes permissible to give further roentgenization, but certain contraindications must be noted. In the first place it is imperative to question and make written record of whether the patient has had an erythema at any time during previous treatment. If the treatment was given by someone else and there was any indication of an erythema, further x-ray treatment shoud be withheld. Atrophy and telangiectasis may develop in from one to ten years following excessive dosage, and in order to avoid possible criticism the above rule should be unchangeable. Wrinkling about the mouth, excessive dryness, loss of elasticity, or severer forms of sequelae from overirradiation are also inalterable contraindications to a repetition of x-ray treatment. In the absence of these contraindications or other clinical evidences of overirradiation it is safe to continue the roentgen treatment.

Sequelae.—In careful practical work the principal dangers are wrinkles or persistent excessive dryness. Wrinkling is more liable to occur in thin undernourished patients and in those over thirty, than in younger girls with plump faces. The wrinkles first manifest themselves about the corners of the mouth or chin, on smiling. When present on the forehead or about the eyes they are more likely to be due to some other cause than radiation. Overlapping due to careless shielding is often responsible for undesirable sequelae. In widespread cases telangiectases are likely to be caused by neglect of proper shielding. In any case they may be caused by overdosage. An erythema must be absolutely avoided. Any erythema, no matter how slight, may be followed within eighteen months by atrophy and telangiectasis. Atrophy may, in some instances, occur without a preliminary erythema. Whether or not telangiectasis may occur without a preceding erythema is still a disputed question. The haphazard application of x-rays may result in such sequelae as atrophy, persistent excessive dryness, wrinkles, loss of youthful elasticity and freshness, aged appearance, telangiectasia, depigmentation, keratoses, sclerodermatous changes, chronic ulceration, and even squamous carcinoma.

Pitted scarring is incorrectly ascribed to x-ray treatment. Such scarring is really caused by the disease and is often not noticed until the inflammatory lesions have been eradicated. The worst examples of it are seen in patients who have formerly suffered from acne without ever having received x-ray radiation. As the tendency to scarring in acne is so marked, the early institution of x-ray treatment is of great importance in order that the disease may be cured as soon as possible.

It has been claimed that x-rays cause an increased growth of hair on the face, but this assertion is without grounds. It should be borne in mind, when hypertrichosis is developing gradually any treatment which does not actually check it will seem to favor its increase, since the hair will continue to become more abundant. Hypertrichosis follows acne only in those places where it occurs in the absence of acne, and the possibility suggests itself that it is the larger sebaceous glands and follicles, the probable forerunners of hypertrichosis, which predispose to acne rather than the reverse. Roentgen therapy does not cause a growth of hair on the body when employed in the treatment of generalized dermatoses. As a matter of fact, this form of treatment is occasionally directed against hypertrichosis. There are early reports, however, upon which to base the assumption that fractional exposures of x-rays have a stimulating effect upon the hair follicles in alopecia areata. Kienböck, Holzknecht, Neumann, and others, who were previously of this opinion, later encountered many intractable cases of this disease and realized that the few apparently successful cures as a result of radiation were without doubt spontaneous. The consensus of opinion among modern authorities is that x-rays are of no value in the treatment of alopecia areata. Ullmann thinks it is probable that weak irradiation could be used cosmetically to bring about a growth of hair. However, suffice it to say here that there is no substantial corroborative evidence that x-rays stimulate the growth of hair, and that hypertrichosis when present is in all probability due to the hyperemia caused by the acne itself, by hereditary tendencies, or by the stimulation from irritating drugs used on the skin in the treatment of acne.

As these questions are commonly discussed among the laity and have involved legal proceedings with cost, damages, and publicity, it is advisable that the physician avoid any agent to which the stimulation of hair growth is ascribed, if other methods can be successfully enlisted, and to call the attention of the patient, prior to the institution of any treatment, to the concomitant presence of any hypertrichosis on the face.

Persistent freckles and tanning after radiation therapy of acne tend to disappear without treatment in the course of a few weeks or months.

Advantages of Roentgen Therapy.—It is desirable that acne vulgaris be cured as speedily and permanently as possible, as persistence of the eruption depresses the morale of the patient and favors scarring. Neglect may increase the difficulty of later cure. In severe cases, treatment dependent upon medicinal and hygienic means is often slow, discouraging, and ineffective. Roentgen therapy, together with other dermatological treatment, is the most rapid and satisfactory form of therapy. Fractional x-ray treatment is a safe and almost certain cure in over 90 per cent of the cases. With proper technic, usually three or four months are required for complete involution of the lesions. This is about one half of the period necessary for the successful treatment of the average case by medicinal means. A small percentage of relapses occur after six months or a year, even with the proper technic, but such recurrences, which are no greater than 20 per cent, respond very favorably to two or three subsequent treatments. The number of cases that are incurable remains under 5 per cent. The disease in such instances is usually based upon constitutional conditions and resists any form of treatment.

(*b*) *Ultraviolet Light.*—Ultraviolet light[1] frequently causes more rapid involution of acne vulgaris than is obtainable with x-rays. This form of therapy is useful in all types of the affection, but is especially indicated in superficial, acutely inflammatory cases where there are no notable comedones. Generally the results obtained from ultraviolet rays are not as satisfactory as those derived from roentgen rays, because the improvement is temporary and recurrences are the rule rather than the exception. The depth of the lesions has a large influence on the time required for cure, superficial ones responding much more quickly than those which are indurated.

Before each exposure the skin should be cleansed thoroughly with soap and water, alcohol, or carbon tetrachloride solution, and the individual lesions treated surgically, the comedones being evacuated and the pustules drained. The eyes, ears, and neck are shielded, but not the scalp. During generalized exposures the genitals and breasts are protected.

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[1] Thedering, F.: Über die Strahlenbehandlung der Acne Vulgaris, Ztschr. f. d. ges. physikalische Therap., 32: 152–156, Oct. 28, 1926. (A very practical dissertation.)

In ultraviolet therapy pronounced local effects are desirable. Each exposure should produce a first or second degree reaction, which is followed by a fine dry exfoliation of the epidermis. The desquamation results in the shedding of all but the deep-seated lesions; bacteria are killed, and the erythema stimulates the flaccid superficial muscles and relaxed skin. Before any treatment is given, the patient should be informed of the incidence of an erythema and carefully acquainted with its duration and the subsequent peeling. The dose given is governed somewhat by the patient's acquiescence to the concomitant discomforts. Whereas third degree reactions are preferred by most physicians, including the author, the patient usually is better pleased with less intensity. The stronger reactions evoke more rapid improvement than the milder reactions, but the associated discomfort offsets the difference in improvement.

The carbon arc and mercury arc lamps have been equally effective in my experience. They may be air-cooled or water-cooled, the former being more frequently used than the latter. With either type of construction, the radiation is applied from a distance upon the affected areas. Exposures with the air-cooled lamp are usually given twice weekly at a skin-burner distance of 30 inches. The duration of the exposure is progressively increased from thirty seconds to extended periods of twenty minutes or more, as the toleration of the patient increases.

With the water-cooled mercury arc lamp, the exposures are made to each cheek at a distance of 2½ inches from the skin surface, and, when necessary, separately to the forehead, chin, back, and chest. It is well to begin with exposures of about thirty seconds' duration, the time being increased as the patient's tolerance is determined. Treatment should be repeated at intervals of three or four days.

General body radiation, including exposure of the scalp, is of supplementary assistance to the local treatment. It is used for systemic effect in many types, but is particularly valuable in those such as acne cachecticorum and menstrual acne, which are specially influenced by constitutional conditions.

After the cure of acne vulgaris, particularly the indurated and cystic types, profuse pitted scarring may be an unfortunate disfigurement. The intense reaction produced by blistering exposures of ultraviolet energy is, in most cases, a specific treatment for this sequela. The local hyperemia, which seems to fill in the depressed areas, works in combination with the epidermal exfoliation, which peels off the scars. As a rule, the benefit derived in such cases is gratifying. The scarring may be completely removed by the exfoliation from one ultraviolet-light treatment, but sometimes in severe cases six or eight treatments given at intervals of two weeks are required. Acne scars are rarely incurable by this method, and some improvement always results from it. Of course, the longer the duration of the scarring, the more difficult is the eradication, although I have seen an instance of complete removal, by this method, of profuse pitted scarring of eight years' duration caused by acne. I have also used it with success in a few cases of post-varicellar scarring.

The technic for the removal of scars is similar to that described for the treatment of acne with the exception of additional protection of uninvolved parts. The patient lies on a table without a pillow, with the head flexed slightly backward and rotated into a three-quarter position which brings the center of the cheek uppermost, the chin also being tilted upward. Spectacles of sheet-lead are strapped tightly over the eyes and brows by adhesive tape. The lips are closed and protected by an oblong piece of adhesive tape specially cut for the purpose. The neck, shoulders, ear, and scalp are protected by towels. When the scars are limited to a small patch this technic may be replaced by a simpler procedure—exposure of the affected patch through a hole cut in sheet-lead. When all the shielding is arranged the radiation is applied from a distance of 10 inches for ten to thirty minutes. Soon after the exposure the parts become red and swollen, the reaction reaching its maximum in two days. In the course of a week it gradually subsides with profuse epidermal peeling. During this stage and for the dryness which follows, no unguents are advisable. The benefits of the treatment are apparent about eight weeks later.

Ultraviolet light has been credited with powers of stimulating hair growth, and is used for this purpose on the scalp. Its action is more likely due to the hyperemia caused by the exposures than to any specific action on the hair follicles. A similar opinion is held by Danforth. Female patients who exhibit tendencies to hypertrichosis should be exposed with caution to ultraviolet light in the treatment of acne of the face. The author has never seen more than a slight transient downy fuzz produced in such cases.

There is a tendency among dermatologists, as expressed in recent literature, to use a *combination of ultraviolet light* and *x-ray therapy* in the treatment of acne. If ultraviolet light is employed in conjunction with roentgen therapy, it should be used either after the course of roentgen therapy has been completed or prior to its institution. When thus applied it is of decided value, as has been mentioned. The concomitant local use of ultraviolet light and *x*-rays at the same or alternate sittings is ill-advised, because the dryness, peeling, tanning, or erythema caused by the ultraviolet light obscures the *x*-ray effects, such as dryness, wrinkling, or even erythema. These changes in the skin due to *x*-rays are criteria by which one is guided in the *x*-ray dosage. Obscuring them leads to unwarranted hazards. Tonic body exposures of ultraviolet light may, however, supplement advantageously roentgen treatment of the face so long as the irradiated areas do not overlap.

(*c*) *Radium.*—Radium is rarely used for the treatment of acne vulgaris, but deserves mention in this connection because of its value in the treatment of keloidal acne. The technic for its application is described in Chapter XXIX, page 897, under Keloids.

(*d*) *Topical Applications for Use with Irradation in the Treatment of Acne Vulgaris.*—The combination of topical remedies and *x*-ray treatment is preferable to *x*-ray treatment alone, because by the combination not only is a more rapid cure effected so that there is less scarring, but the result is also accomplished with less irradiation than would be required in the treatment with *x*-rays alone. As previously stated, the author is of the opinion that roentgen therapy in acne vulgaris should be used as an adjunct to other therapeutic procedures, and he does not agree with those who depend largely upon irradiation and do not advise even the use of lotio alba during *x*-ray treatment.

It should be remembered that *x*-rays and topical remedies are reciprocal in their actions, that is, if strong doses of *x*-rays are employed, the topical medications must be weak, and if strong topical applications are used the x-ray dosage must be small. Local applications should never be strong enough to cause inflammation of the skin (dermatitis venenata) and patients with acne so affected should not be treated with roentgen or ultraviolet radiation until two weeks after the disappearance of such inflammation. With the x-ray technic herewith described, the topical remedies as given in the following paragraphs can be judiciously used with perfect safety. The author expects average clinical perception and care from the operator. During ultraviolet therapy the local applications can lead to no serious harm, but in general should be given as here described in order to avoid discomfort to the patient from aggravated ultraviolet reactions as the result of strong remedies. As individuals vary in their degree of toleration to drugs and as some skins affected with acne are extremely sensitive, considerable experience is necessary in order to be able to select proper remedies. No set rules can be formulated except that in every case mild applications should be at first employed and the strength of the application increased as the degree of toleration permits.

The dermatologist should prohibit the use of all proprietary cosmetics because their ingredients are usually unknown and are sometimes harmful. Whenever infection is present, creams and greasy cleansing agents should not be used, as rubbing them on and off the face tends to spread the inflammation. Facial packs and facial massage have a similar tendency and should never be used in the presence of infection. These procedures, however, are beneficial when the acne consists only of comedones, or in the after-treatment of the skin subsequent to the eradication of the infection, strict cleanliness being observed in them.

Specific admonitions regarding the *cleansing* of the skin are important. Dry skins are usually not affected by acne vulgaris, but when such involvement occurs cleansing is performed by superfatted toilet soaps or oily emulsions, in accordance with the following formulas:

℞.	Petrolat. liq. (light),	
	Glycerini	āā 70
	Aq. hamamelidis,	
	Aq. camphorae	āā 20

M. and S. Use on cotton for cleansing skin. Shake label.

℞.	Adipis lanae,	
	Ung. aquae rosae,	
	Ol. cocoanut,	
	Gum tragacanth,	
	Saponis	āā ʒj
	Sodii boratis	ʒij
	Ol. amygdalae amarae	gtt. xv
	Aq. hamamelidis	q.s. ad. ℥iv

Gradually add the witch hazel to the other ingredients with constant stirring until a thick paste is obtained, after which it may be added in quantity.

Sig. Use on cotton for cleansing skin.

For delicate skins or those not noticeably oily, cleansing with castile soap or pulverized almond meal is advocated. The former is preferable where infection is present, and the latter is indicated in the absence of infection, where the disease consists largely of comedones. In moderately oily skins, gentle cleansing, without irritation, with tincture of green soap, toilet soaps, or an alkaline cleansing solution is advisable.

℞. Petrolat. liquid	℥ss
Magma magnesiae	℥iv
Potass. carbonat	gr. xv
Mentholis	gr. iv
Glycerini	ʒj
Spt. vini rect	℥j
Aq. aurantii florum ... q.s. ad.	℥viij

M. and S. Shake and use on cotton for cleansing the skin.

Where the oil is excessive, additional effect may be obtained by the use of solvent cleansing lotions containing alcohol, acetone, spirit of ether or carbon tetrachloride.

℞. Acetone,	
Eau de cologne ... āā	℥j
Aquae dest ... q.s. ad.	℥iv

M. and S. Use a few drops on cotton for cleansing oil from the skin.

℞. Spt. aetheris comp. (Hoffman's drops)	ʒiij
Spt. vini rect ... q.s. ad.	℥iv
Persionis (Cudbear)	gr. ¼

M. and S. Use a few drops on cotton for cleansing oil from the skin.

℞. Carbon. tetrachlorid	ʒij
Spt. vini rect	℥ij
Mentholis	gr. iv
Sodii boratis	gr. xx
Glycerini	ʒj
Aquae hamamelidis	℥j
Ol. aurantii florum	gtt. vj
Ol. rosae	gtt. viij
Aquae dest ... q.s. ad.	℥viij

M. and S. Use a few drops on cotton for cleansing oil from the skin.

Tar soaps are stimulating, but this advantage is offset by the lay impression that they cause a growth of hair. Soaps containing sulphur, mercury, camphor, balsam of Peru, resorcin, phenol, cresol, and other drugs possess slight individual advantages. Supplementary cleansing may be accomplished by a very thorough facial shampoo given by the patient with shaving soap twice weekly. Where comedones are profuse and infection is absent, the lather may be scraped off the skin with an inverted tablespoon, which gently expresses small comedones. The skin is then bathed with hot water to which has been added a few drops of tincture of benzoin or with medicated soap containing sulphur and camphor or alcohol. A similar cleansing is effected in the abence of infections by almond meal fortified as follows:

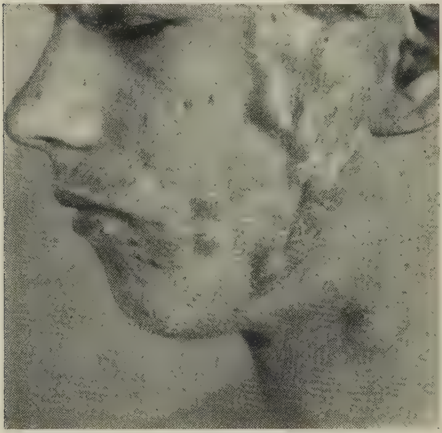

Fig. 333.—Keloidal type of acne.

℞. Potassii carbonat.,	
Sodii borat ... āā	ʒss
Quillajae	gr. x
Almond meal ... q.s. ad.	℥iv
Dactylis	gtt. x

M. and S. Use at time of bath for cleansing the face and neck. After moistening skin, rub in and then rinse off without delay.

In every case the patient should be advised to buy hand-towels and to use a fresh one for drying the skin at each washing.

For female patients a mildly antiseptic *face powder* may be prescribed. It should contain no lead or other harmful ingredients. Some persons have an idiosyncrasy toward orris root, in which case this should be omitted. The powder should be passed through a No. 100 strainer and tinted and perfumed to meet the patient's desire. Titanium oxide, 5 to 20 per cent, may be added to increase the sticking of the powder to the skin. It is very important that soiled powder puffs should not be used. The patient should be advised to buy one half dozen powder puffs and wash them frequently, so that a fresh one may be used each day. A formula for face powder is appended:

℞.	Zinc. oxidi	℥ss
	Adipis lanae	ʒij
	Amyli (rice)	℥viij
	Bismuth. subcarb	℥j
	Magnes. carb	℥ij
	Pulv. orris	℥j
	Talc	℥ij
	Odor and color	q.s.

Various popular shades are made by the addition of the following ingredients: Calamine, cosmetique brown, Bismarck brown, alkanet, Van Dyke brown, and bol. armen.

Of the *local curative applications*, lotio alba, salicylic acid in alcohol, and beta naphthol in soap and cold cream are by far the most effective. The ordinary lotio alba is so weak that it is only mildly effective upon delicate skins. For the average case a stronger solution may be compounded. At bedtime, after the face is cleansed, this lotion is rubbed gently into the affected areas.

A good *lotio alba* is composed of saturated solutions of zinc sulphate and potassa sulphurata, made up separately. The latter must be fresh. These solutions should be rapidly added one to the other with constant stirring, and allowed to stand twenty-four hours, after which time the supernatant fluid is discarded and strong eau de Cologne is added to the precipitate in a quantity sufficient for perfume. Made in this manner the lotion is white and creamy with a pleasant odor. Glycerin may be added but is not well tolerated by some skins. This mixture may also be fortified by the admixture of resorcin or betanaphthol.

Vleminckx's solution may be used in obdurate cases but is objectionable because of its odor and staining. It is usually too strong by itself, but may be mixed with an equal amount of lotio alba. Sulphur is not tolerated by some skins, and in such instances other drugs may be substituted for it. Calamine lotion, zinc oxide ointment, bichloride of mercury, and camphor may fulfil such requirements, as denoted in the following formulas:

℞.	Phenolis		gr. xx
	Calamin. praep.,		
	Zinci oxidi	āā	ʒij
	Glycerini		ʒj
	Aquae camphorae,		
	Aquae hamamelidis	āā q.s. ad.	℥iv

M. and S. For use during daytime.

℞.	Hydrarg. chlor. corros		gr. ij
	Mentholis		gr. v
	Glycerini		ʒiv
	Spt. vini rect		℥ij
	Aquae destillat	q.s. ad.	℥vj
	Eau de Cologne	q.s.	for odor

℞.	Sulphur. praecip	ʒiv
	Camphor. pulv	gr. x
	Tragacanth. pulv	gr. xx
	Aquae calcis,	
	Aquae destillat	āā q.s. ad. ℥iv

M. and S. Shake well and apply a coating over affected areas.

℞.	Zinc. phenolsulph	ʒss
	Spt. camphorae	ʒiv
	Aquae rosae	℥j
	Aquae destillat	q.s. ad. ℥iv
	Chlorophyll	q.s. for color

When comedones are profuse and large, *peeling* is of value and may be accomplished by stronger remedies than those mentioned above. This should be done prior to and not during *x*-ray treatment. Alcoholic solutions of bichloride of mercury (1 : 1000), 2 or 3 per cent salicylic acid, 5 to 10 per cent resorcin, or the following ointment will prove of value:

℞.	Betanaphthol	ʒss–ij
	Sulphur. praecip	ʒii–iv
	Saponis viridis	ʒij
	Ungent. aquae rosae	q.s. ad. ℥ij

M. and S. Rub into the skin at bedtime.

Milder measures are the use of almond meal containing small amounts of sodium borate or potassium carbonate and soaps containing Fuller's earth for cleansing throughout the entire period of treatment. These remedies are sometimes of benefit following *x*-ray treatment when the scars of the acne remain and require removal, although usually blistering exposures of ultraviolet light are of superior value. As has been mentioned, in all cases *local surgical treatment* is imperative. As often as is feasible, such pustules as are present should be evacuated and the comedones expressed. This surgical cleansing should be gently and diligently performed by the physician with strict asepsis, a pointed scalpel, or a Hagedorn needle, and a comedone extractor being used.

Dryness during *x*-ray treatment from inhibition of the secretions may be relieved by the following formulas:

℞.	Petrolat. liquid	ʒiv
	Petrolat. albi	ʒiij
	Paraffin	ʒj
	Ol. Oriental	gtt. iij

Mix.

℞.	Ol. amygd. dulc	ʒij
	Cerae albae	ʒss
	Cetacei	ʒss
	Oil cocoanut	ʒj
	Adipis lanae	ʒj
	Aquae rosae, fort	ʒij
	Tinct. benzoini	gtt. ij
	Ol. amygd. amar	gtt. ij

(Melt all and add tincture benzoin and oil of bitter almonds when almost cool.)
M. and S. Massage into dry skin at bedtime.

When such dryness is permanent due to atrophy of the sweat and sebaceous glands, this formula should be used indefinitely. It is also employed in instances of wrinkling due to excessive dryness, or atrophy of the elastic tissue. In these cases stimulation of the skin circulation, daily massage, steaming of the face and outdoor exercise should be prescribed. In severe cases the following stimulant may be rubbed into the affected areas two or three times weekly:

℞.	Oleoresin. capsici	gtt. 40
	Ol. theobromatis	q.s. ad. ℥j

M. and S. Rub into the affected areas until they become red. Then remove with mineral oil on cotton. To be followed by the application of cracked ice.

Careful *x*-ray dosage should effect a cure without these sequelae. *Freckles* and *tanning* persisting after radiation gradually disappear without treatment, but their elimination may be hastened by the application of weak bichloride of mercury cream, or lemon juice. Formulas for bleaching creams are:

℞.	Hydrarg. chlorid. corrosiv	gr. $\frac{1}{3}$
	Bismuthi oxychloridi	gr. $\frac{1}{8}$
	Adipis lanae	ʒj
	Unguenti aquae rosae	q.s. ad. ℥j
	Oil jasmine	♏ij

Add bichloride to oil and 1 dram of alcohol. Melt all the other ingredients and when sufficiently cool add oil solution.

℞.	Hydrogen. peroxid	℥ss
	Bismuthi oxychloridi	ʒiss
	Aquafor (Metz)	℥j
	Ol. limonis	gtt. ij

℞.	Acidi citrici	ʒj
	Petrolati flavi	ʒij
	Adipis lanae	ʒj
	Petrolati liquidi	ʒij
	Cerae albae	ʒj
	Aquae	℥j
	Olei limonis	gtt. ij to each oz.
	Turmeric	gr. j

M. and S. Lemon cream.

The cure of acne is frequently expedited by concomitant antiseptic treatment of the scalp along the lines described in detail under seborrheic dermatitis (page 413).

2. *General Treatment.*—An excess of carbohydrates should be avoided in the *diet* and sufficient fluid and bulk given to alleviate intestinal stasis. Two glasses of water should be taken before breakfast and two glasses at 10.30 A. M. and at 4.30 P. M., and two glasses before retiring. Some kind of fruit should be eaten at every meal and either two green vegetables or a green vegetable and a salad should be eaten at both luncheon and dinner. Pastry, candy, ice cream soda, cereals, breadstuffs, sweets, and starchy vegetables should be avoided. Appended hereto is a diet suitable for most cases of acne vulgaris.

Beverages Not Allowed:	**Foods Not Allowed:**
Alcohol	Candy
Tea	Ice cream soda
Chocolate	French ice cream
Coffee	Gravies
Cocoa	Pastry

May have 1 cup of weak tea or coffee at breakfast.
Avoid excess of starchy foods, such as potatoes, cereals, spaghetti, noodles, white bread.
Avoid batter foods.
Eat meat only once a day. Take largely vegetable diet.

Allowed breadstuffs, cereals, dairy products, ice cream, milk, and egg desserts and other simple desserts; unless otherwise instructed.

Vegetables Suggested:

- Artichokes
- Asparagus
- Beans
- Beets
- Broccoli
- Brussels sprouts
- Cabbage
- Carrots (young)
- Cauliflower
- Celery
- Cresses
- Cucumber (baked)
- Dandelion greens
- Eggplant (stewed or grilled)
- Endive
- Greens
- Kohlrabi
- Leeks
- Lettuce
- Mushrooms
- Onions (boiled)
- Oyster plant
- Peas
- Parsnips
- Pumpkins
- Radishes
- Rhubarb
- Sorrell
- Spinach
- Swiss chard
- Squash
- Tomatoes
- Turnips
- Vegetable marrow

Eat slowly and chew your food well.

If *constipation* is present, special directions should be given concerning morning exercises, and when necessary, mild laxatives should not be withheld. The patient should be advised to have a regular time for evacuation. Yeast has an undetermined usefulness in the treatment of acne vulgaris and seems of most benefit in cases where constipation requires relief. An excellent laxative is one consisting of the following formula:

℞.	Ferri sulphatis	gr. x
	Magnesii sulphatis	ʒj
	Acidi sulphurici dil	ʒj
	Aquae menthae piperitae q.s. ad.	℥iv

M. and S. One tablespoonful in water before breakfast.

Laxatives may be combined with *tonics* containing arsenic, iron, or strychnine. Rhubarb seems to have a specially beneficial action in acne.

℞.	Liq. potassii arsenitis	ʒj
	Tinct. nucis vomicae	ʒij
	Fldext. rhamni purshianae	℥ss
	Mist. rhei et sodae q.s. ad.	℥viij

M. and S. One teaspoonful in water three times a day after meals.

Tonics containing iodides and bromides are strictly contraindicated. Thyroid extract is occasionally of value in obese patients of the Froehlich type, but the administration of various glandular extracts is otherwise disappointing.

Vaccine therapy is occasionally of benefit, autogenous preparations being preferable to stock products. One objection to the use of vaccines is that their action is slow and often only temporary. I have found them most useful in patients with pustules from which culture showed an almost pure growth of Staphylococcus aureus, and in which the acne bacillus and Staphylococcus albus were scarce or absent. Vaccines made from the last two have been of no use in patients from whom they were solely and repeatedly obtained in profuse numbers. The vaccine dosage should be sufficient to cause a moderately severe local reaction and repeated in gradually increasing amounts at four- or five-day intervals, until a course of fifteen or twenty injections has been given. *Nonspecific protein therapy* in the form of intradermal, subcutaneous, and intravenous injections possesses little value.

Their use is principally as an adjunct to other forms of treatment; for which purpose they are inferior to autogenous vaccines.

Recalcitrant cases of acne vulgaris are sometimes related to *systemic disorders*. The urine should be examined and corrective measures instituted for any abnormalities discovered in it. Focal infections should be sought and eliminated in all cases stubborn to treatment. Chronic appendicitis or tonsillitis, tuberculosis of the lungs or peribronchial glands, and other infections must often be cured before the treatment of acne meets with success.

CLINICAL TYPES

Comedo (*Blackhead*).—If the eruption is made up entirely of small comedones and is located upon the forehead or cheeks, thorough cleansing morning and night with tincture of green soap or pulverized almond meal containing 10 grains of potassium carbonate or sodium borate and 10 grains of powdered soap bark to the ounce, or hand sapolio or very fine pumice will frequently be curative, especially when aided by the expression of comedones and local applications of lotio alba or 3 per cent salicylic acid in alcohol.

Small comedones are often located about the mouth. In this location x-rays are of no benefit because of the danger of wrinkling. Careful expression, a rolling cream of Fuller's earth, and pulverized almond meal are useful in these cases.

℞.	Kaolin	30 per cent
	Fuller's earth	50 "
	Witch hazel	10 "
	Tragacanth	2 "
	Water	2 "

Santal oil, faint trace.

When profuse numbers of large comedones are on the forehead or cheeks, or in or about the ears, unfiltered x-rays are an ideal method of treatment. The mouth and lower parts of the face should be shielded from the irradiation. The comedones are expressed by the physician each week prior to the irradiation. Numerous large comedones on the neck, back, shoulders, and upper arms respond well to irradiation, but care must be exercised to prevent excessive overlapping, which is the most common cause of unexpected erythemas and subsequent telangiectasis.

Acne Pustulosa.—This is a type of small superficial pustular acne, which is principally a staphylococcus dermatitis occurring infrequently in young girls with delicate skins. There are practically no comedones associated with this eruption. Ultraviolet light, ammoniated mercury ointment, other antiseptic applications, and vaccines are more effective than x-rays in these cases. In fact, x-rays are, as a rule, useless on this type of acne, as well as hazardous on such delicate skin.

Acne Papulosa.—Small papular acne is frequently associated with profuse numbers of large comedones which have become inflamed, probably from the acne bacillus. This type of acne is most common in males with coarse, oily skins. It yields readily to x-ray treatment, combined with local medicinal measures.

Acne Indurata.—Papular acne often progresses into the indurated type due to secondary staphylococcus infection. The lesions then are deep-seated and destructive and may be papular, pustular, or mixed. If the eruption has been present for some length of time, scarring is often severe.

Focal infections and systemic disorders should be sought and removed. Topical remedies are of very little value; roentgenotherapy is unquestionably the most effective method of treatment. In the majority of these cases filtered radiation is advisable. However, it is good practice to use either unfiltered or filtered therapy, and many dermatologists resort only to filtered treatment of those patients who have failed to respond to a moderate number of unfiltered exposures.

Cystic Acne.—Uncommonly these lesions may develop either in association with the latter type or subsequent to an inflammatory type of acne as an entity on a basis of seborrhea and large comedones. The cysts are a form of tissue reaction about small hard deposits of sebum, which act like foreign bodies. The contents are jelly-like, of granular and serosanguineous fluid. Although the cysts are of a sebaceous origin and apparently identical with wens, either because of their acuteness or different types of contents, being rarely cheesy, they respond far more favorably to irradiation. The cysts may be incised and drained, but the relief is temporary unless the particles of inspissated sebum are completely removed, and for this reason it is advisable to curet the interior of the cysts. On account of the liability to scarring one should at first employ a minimum of surgery and rely mostly upon irradiation. Either filtered or unfiltered *x*-rays, or erythema exposures of ultraviolet light may be given. The latter is particularly useful for producing congestion of the skin, and absorption of the cysts after their lining membranes have been destroyed by roentgen rays. Nonspecific proteins are occasionally injected with benefit in conjunction with irradiation. Cystic acne is prone to scarring and roentgen rays should therefore be applied with extra caution. Overtreatment, with rapid involution of the cysts, may cause retraction of the skin where the cysts are large and adherent to the subcutaneous tissues and the corium. When radiotherapy is unsuccessful, surgical drainage is necessary.

Acne Atrophica.—Infrequently, in the small papular cases, after the lesions disappear, they leave a kind of stippling formed of tiny atrophic pits and scars. The affected skin gradually becomes disfigured by these numberless, minute depressions. This type of acne should first be treated by fractional *x*-rays until the new lesions have ceased to evolute, and after this point is reached the scars may be improved or eradicated by blistering exposures of ultraviolet light. The technic for this treatment has been described in detail (page 497).

Acne Necrotica or Acne Varioliformis (***Acne Frontalis***).—This is a superficial, indolent, papulopustular eruption, which is often classed as a tuberculide. The lesions are follicular papules, which rapidly undergo central necrosis, and upon evolution cause fairly large pitted scars similar to those of variola. The disease is generally located on the scalp, forehead, or nose, and responds temporarily to many measures, including irradiation. Five per cent ointments of sulphur and betanaphthol, or ammoniated mercury or salicylic acid are usually as efficacious as *x*-rays or ultraviolet light. For the hairy regions, lotions containing mercury bichloride or resorcin are used. In some cases, however, irradiation seems to evoke a more rapid cure, and to deter the liability to recurrences more than any medicinal treatment.

Benefit is derived from both ultraviolet and roentgen radiation, the former being preferable. A second degree erythema produced by distance application of either the mercury or carbon arc type of lamp usually suffices to cause involution of all lesions. In order to avoid immediate recurrences the treatment should be repeated at weekly intervals for six or eight exposures. If x-rays are used, fractional unfiltered therapy is satisfactory. When the lesions occur on the scalp, the Kienböck-Adamson method, as described for tinea capitis, is employed and the dosage is made subfractional, consisting of $\frac{1}{8}$ E. D. weekly. These treatments may be continued for four weeks, after which it is necessary to give a rest interval of four weeks before proceeding with roentgen exposure. The w-rays are also curative.

Acne Cachecticorum.—This variety is characterized by indolent, soft, scarcely infiltrated, pustular lesions almost lacking in inflammatory reaction, cyst abscesses, nodules, and scarring. The affection may appear in any location where the pilosebaceous follicles are present, but in this type the comedones are sometimes barely noticeable. Acne cachecticorum usually occurs in debilitated patients and in these instances, in addition to pulmonary tuberculosis, other diseases—notably bronchiectasis, lung abscess, diabetes, and anemia—should be thoroughly sought by an internist. Improvement of the general health of the patient is the most direct means of curing the skin condition. High calorie diet, rest, and tonics of calcium, iron and phosphorus are useful; tonic treatment by generalized ultraviolet irradiation is indicated. The dosage at first should be mild, about thirty seconds at 30 inches distance to each area, in order to avoid overstimulation or collapse, which may follow too vigorous use of the light. Treatments should be given daily and continued for two or three months.

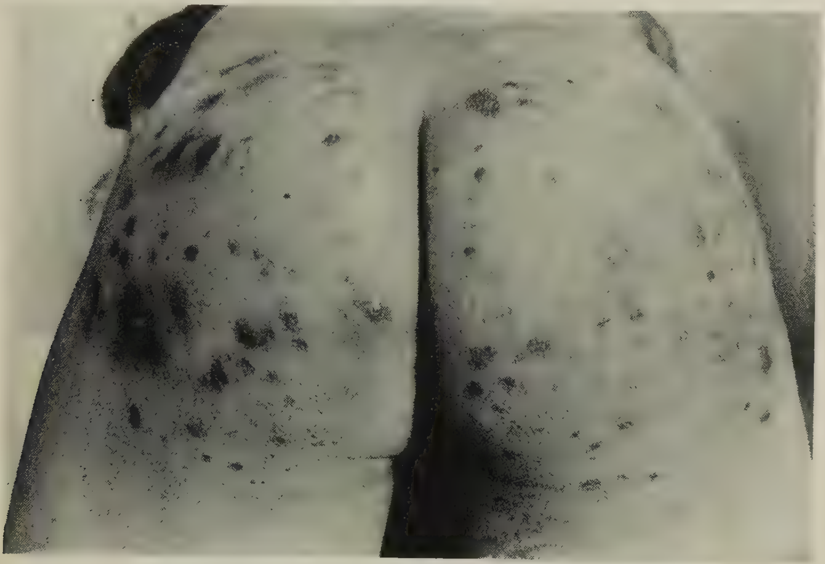

Fig. 334.—Acne of the buttocks. Indurated, papular type.

Locally, second degree reactions produced once weekly by ultraviolet light cause rapid absorption of the lesions, but fractional x-ray therapy is more desirable because its benefits are more lasting. This type of case responds so rapidly to roentgen therapy that one must exert care in order to refrain from unnecessary exposures.

Acne Keloid.—This is a type of acne with hypertrophic scarring. It may be subdivided into more or less definite clinical varieties.

1. Numberless *small keloidal scars* of the face as a result of small papular acne. This is most frequently seen in the negro race. It is not infrequent in adult colored males on the bearded region, where it is perhaps augmented by shaving.

2. *Keloids Accompanying Cystic Acne.*—This type is uncommon, most of the cases occurring in the white race. The areas affected are usually the face, ears, chest, and back.

3. *Dermatitis Papillaris Capillitii.*—This affection is usually located on the nape of the neck. The underlying cause is the presence of numerous large comedones, which are often double, forming little tunnels beneath the skin. More or less infection is present, which leads to follicular papules and occasional pustules. In the course of years the elementary lesions tend to coalesce and form keloidal thickenings.

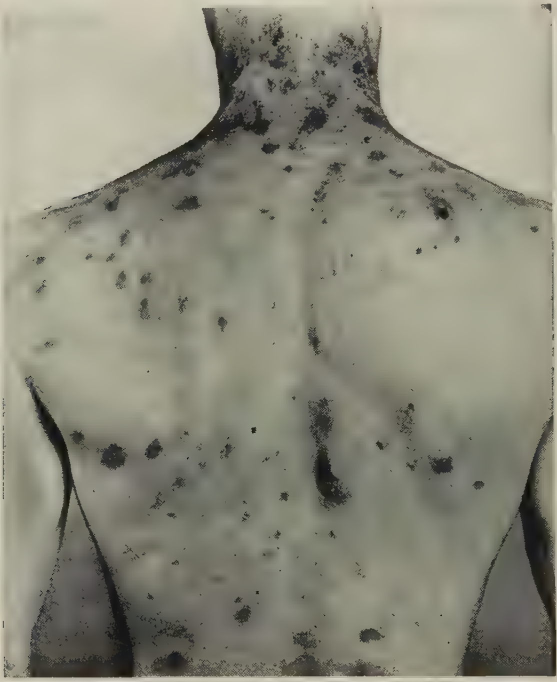

Fig. 335.—Acne of the back with considerable scarring.

4. *Keloids* occurring sporadically in acne vulgaris. This group includes miscellaneous cases not comprehended by the three preceding forms.

x-Rays are particularly useful in all types of keloidal acne, because medicinal remedies are of little value. Whereas good results are obtained in many cases with unfiltered x-rays, radiation filtered through 3 mm. aluminum is preferable. The exposures should be $\frac{1}{6}$ E. D., filtered, given every other week, care being observed to keep the dose below that which would cause an epilation. Resistant cases sometimes respond better to harder radiation—radium rays filtered through brass.

Throughout treatment single comedones should be evacuated by expression of their contents, and double comedones should be slit open with a scalpel and touched with phenol on a toothpick, so that the slit edges will remain separated. Local medications for the scalp for dandruff deter the development of new lesions.

Acne Dorsalis and Other Varieties.—Acne of the back may be treated similarly to the lesions on the face, except that cleansing is usually best accomplished with a scrubbing brush and tincture of green soap in a shower bath morning and night. The patient should remain in the hot water long enough for the back to become very red. If tub baths are taken, 15 to 30 grains of zinc sulphate may be dissolved in each tub of water, according to the tolerance of the skin. The baths are followed by a rubbing of the affected area with lotio alba. In pustular cases the underclothes should be kept scrupulously clean. Mitchell has verbally recommended pills of quinine sulphate, and I have seen some benefit from sodium thiosulphate *per os.* Roentgen irradiation, with careful avoidance of excessive overlapping, is indicated concomitantly with this treatment.

A peculiar type of superficial acne has been given the name "acne excoriée des jeunes filles" by Brocq and is caused principally by the neurotic habit of picking the face and squeezing out blackheads which are too small to be seen even by close scrutiny. This type of acne should be treated largely by soothing remedies and psychotherapy. Practical points are the avoidance of unreasonable efforts at cleanliness, and prohibiting the use of magnifying mirrors and of long fingernails.

Acne vulgaris on other parts of the body is treated in accordance with the general principles already described. Acneiform eruptions of industrial or medicinal origin are produced by petroleum products, lubricating oils, tar, iodine, bromine, chlorine, and other substances. Although commonly called "trade acne," "bromine acne," and "chlor-acne," they are not forms of acne vulgaris. The treatment of these affections, after the obvious cause has been removed and combated, is similar to that described for folliculitis.

ROSACEA

Synonyms.—Acne rosacea, acne erythematosa.

This affection may occur alone or be superimposed upon persistent acne vulgaris. It is, however, a distinct entity. As the treatment of both diseases has many points in common, it is considered in this place.

Rosacea is a chronic disturbance of the flush-areas of the face which leads to permanent hyperemia and the development of acneiform lesions, telangiectasis, and hypertrophy of the skin of the nose known as rhinophyma. Its course is divided into three stages, as follows:

1. Flushing of the malar surfaces, nose, and chin, which in some instances may be more widely spread.
2. A stage in which the above areas tend to become a deeper red or purplish-red with chronic dilatation of the superficial capillaries (telangiectasis) and inflammatory, follicular papules or acne-like pustules.
3. In the final stage, known as rhinophyma, the skin of the nose is congested, coarsened, and thickened, forming large nodular masses covered with pitted scars. The surface is cold and clammy to the touch and becomes pale when pressed. It may closely resemble the congestive form of lupus erythematosus, the lesions of which are more clearly defined, with slightly raised borders.

Rosacea is a condition which may apparently be caused by several factors. Of major importance are those associated with the gastro-intestinal tract. Long-continued consumption of stimulants, especially alcohol and hot tea, or spices, or overeating, gastric derangements, chronic appendicitis, or cholecystitis, and constipation have frequently been observed. In some cases, a disturbance of the female reproductive system, particularly the menopause, seems related to the onset of the condition. When the lesions are markedly pustular, the antra are almost invariably diseased, but whether this involvement is causative or simply a part of the rosacea, like conjunctivitis, is undetermined. It is probable that focal infections cause some cases.

Treatment.—In the earlier stages of rosacea more benefit is derived from local and systemic medicinal treatment than from irradiation. The diet should be bland and directed against intestinal fermentation or putrefaction if either is present.

Diet:

Drink two glasses of tepid or cool water upon arising. Also drink two glasses of water at 10.30 A. M. and 4.00 P. M. and at bedtime.

Beverages Not Allowed:
- **Tea**
- **Coffee**
- **Alcohol**
- **Allowed 1 cup of warm (not hot) coffee or tea at breakfast**

Foods Not Allowed:
- **Spices**
- **Gravies**
- **Condiments**
- **Rich foods**
- **Rich sauces**
- **Hot soups**
- **Hot foods**
- **Hot drinks**
- **Sweets**

Especially Advised:
Vegetable diet and allowed small portion of meat once daily.
Fruits cooked without sugar.
Foods may be warm but never hot.
It is better to eat small amounts often, avoiding large meals.
Avoid constipation and rapid eating. If constipated, add one handful of senna leaves to each pound of fruit prior to cooking.

When there is hypochlorhydria one teaspoonful of dilute hydrochloric acid in water should be sipped during meals. Although hypochlorhydria is more common than hyperchlorhydria, a few patients show the latter and require alkalies, which should be given in water between meals. Thyroid and ovarian extracts have been serviceable in my hands when the condition begins near the menopause. Local treatment of the disease is largely symptomatic. Any manipulation or irritation of the areas is to be avoided; massage and face packs are particularly objectionable. The skin is best cleansed with soothing solutions, according to the formulas given on pages 499 and 500, or with a stearin cream, which is rinsed off by cold water.

℞.	Stearin	℥iss
	Petrolati liquidi (light)	℥j
	Sodii boratis	gr. xx
	Potassii hydroxid	gr. xxiij
	Aquae destillat	℥viiss

M. and S. Cleansing cream. Rinse off with warm water and follow by ice-cold water.

Soap and water and greasy cleansing cream should be avoided. Lotio alba is effective in all stages of the disease. Its strength may be varied by admixture of camphor water to meet the requirements of the individual case. The following sulphur lotion containing camphor may be used after cleansing the face in the daytime.

℞.	Zinci oxidi	℥j
	Zinci sulphatis	ʒij
	Mentholis	gr. x
	Glycerini	ʒj
	Aquae camphorae,	
	Liq. aluminis acetatis ....āā q.s. ad.	℥viij

M. and S. Shake and apply to affected areas during daytime.

℞.	Powdered alum	ʒij
	Face powder (see page 501)	℥ij

M. and S. Astringent face powder.

In the second stage where there are dilated venules and papules or pustules, these manifestations yield to definite therapeutic measures. The dilated venules should be treated by electrolysis, scarification, or electrodesiccation. The technic for the removal of these vessels follows that described for telangiectasia under Radiodermatitis (page 286). Indolent rosacea papules heal rapidly when touched with a small high frequency spark (desiccation). Distance applications of ultraviolet light applied twice weekly with first or second degree reactions are extremely beneficial in the pustular and papular types of the disease. The hyperemia which follows the exposure leads to a rapid absorption of the exudate. The whole appearance of the skin improves wonderfully after a few exposures, and the usual contrast between the red nose and paler coloring of the other parts soon disappears in the general pigmentation which follows the irradiation. My results from this treatment have been slightly better in the pustular type than in rosacea papulosa. Blistering should be avoided.

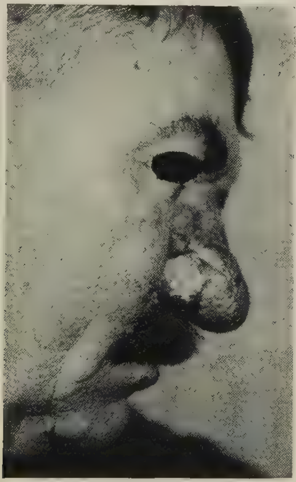

Fig. 336.—Rosacea with moderate hypertrophy of the nose.

Fractional exposures of x-rays are of slight value in both the papular and pustular types. The author has observed no difference between the results of filtered and unfiltered radiation in these cases. The results from all types of irradiation are usually temporary, those from ultraviolet light, however, being superior to those from x-rays.

In the third stage known as *rhinophyma* surgical diathermy is an ideal method of treatment. After the sebaceous material from the glands is expressed as thoroughly as possible, the nose is painted with tincture of iodine and anesthetized by a 2 per cent solution of novocaine and adrenalin infiltrated into the affected tissues with a fine and sharp needle. Redundant tissue is destroyed by desiccation or removed by the cutting current as deeply as necessary to insure restoration of the nose to its normal size and shape. The entire operation is bloodless. A sharp scalpel or razor is useful to pare off remnants of desiccated tissue. After a few days the superficial slough separates, leaving a sterile ulcer. The after-treatment advised by Clark is most satisfactory. After being cleansed with a weak solution of peroxide of hydrogen the areas are washed off with a boric acid solution, thoroughly dried and painted with a 2 per cent solution of dichloramine-T and chlorcosane. This is covered with parresine gauze, over which is laid sterile vaseline lint. Dressings are changed daily to avoid the formation of hard crusts. Three to five weeks are required for complete healing, the cosmetic results being excellent. As a matter of convenience, it is occasionally desirable to treat parts of the growth serially instead of the entire condition at one session.

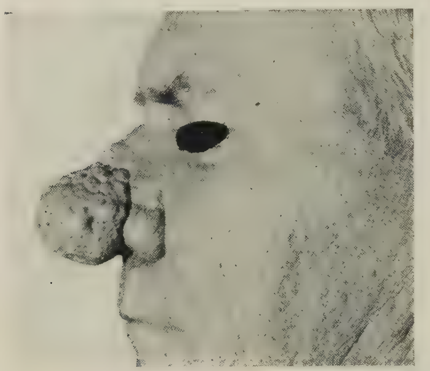
Fig. 337.

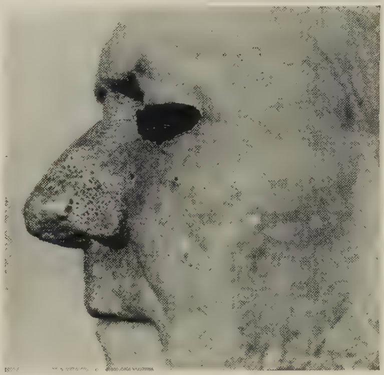
Fig. 338.

Figs. 337, 338.—Rhinophyma. Before and after treatment by electrodesiccation.

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CHAPTER XXI

MISCELLANEOUS PYOGENIC INFECTIONS

SYCOSIS VULGARIS

Synonyms.—Sycosis nonparasitica, sycosis, folliculitis barbae, coccogenic sycosis.

This disease, frequently known as "barber's itch," is a chronic perifollicular, pustular staphylococcus infection of the bearded region characterized by the presence of inflammatory papules and pustules, and a tendency to scarring. Very often the areas between the follicles are erythematous and scaly. In long-standing cases cicatricial changes are pronounced and occasionally a large atrophic area is bordered by pustules and crusts (lupoid sycosis). The disease may affect other short-haired areas, such as the eyebrows, eyelashes, axillae, pubis, and thighs. Focal infections or mucopurulent discharges, as from the nostrils, or direct infection from shaving may cause the eruption, especially in individuals of low resistance.

The disease begins with one or more pinhead-sized pustules pierced by hairs. These rupture, due to shaving or washing, and leave an erythematous spot which is later the site of a fresh crop of pustules. In this manner the affection persists and it gradually spreads. With the formation of pus about the hairs, they become loose and can be readily epilated.

The upper lip, near the nose, is the commonest location for the disease, the cheeks and under lip are next frequent sites, and sometimes the entire bearded region is infected.

Differential Diagnosis.—The condition must be principally differentiated from tinea barbae (parasitic sycosis), facial eczema, lupoid sycosis (ulerythema sycosiforme), lupus erythematosus, herpes, and epithelioma. Tinea barbae rarely affects the upper lip, which is a common location for the staphylococcic variety. In tinea barbae the involvement usually is in the submaxillary region or on the chin, the eyelids and eyebrows being free from the disease. The lesions are either superficial scaly patches or circumscribed, nodular, boggy swellings or subcutaneous lumps, and the ringworm fungus is demonstrable. Sycosis vulgaris may last indefinitely, but ringworm of the beard is a more inflammatory process which is generally of shorter duration. The most chronic indolent type of sycosis is the lupoid form. This is a staphylococcic infection which, by peripheral extension and central scar formation, forms a patch somewhat resembling lupus vulgaris, for which reason it has its name. In facial eczema the patches are erythematous and scaly, and there are no follicular pustules. The involved areas are often symmetrical and there is a tendency for the hair line and eyebrows, as well as the nasolabial angle and ears, to be affected. In lupus erythematosus the patches occur without reference to the hairs and there is no pustulation, but characteristic circumscribed, persistently erythematous patches with adherent scales, patulous follicular openings, telangiectasis, and atrophy. In herpes simplex the duration is only a few days and there are vesicles and crusts which are sufficient to differentiate the disease from sycosis. Small patches of sycosis may at times be confused with basal-cell epithelioma, but lack the infiltration and pearly border.

Treatment.—Sycosis vulgaris may be the simplest or the most difficult disease to cure. In some patients rapid involution is caused by 10 per cent ammoniated mercury ointment without even manual depilation, whereas in others permanent alopecia established by *x*-rays, together with all kinds of local antiseptics and vaccines, fails to produce a cure. In all cases certain therapeutic prerequisites are necessary. The general health, focal infections of the paranasal sinuses, mucoid or watery discharges from polypi and hypertrophied turbinates, chronic tonsillitis, pyorrhea, and decayed teeth should be treated.

Cleansing of the skin should be gently accomplished by mineral oil with the avoidance of soap and water. Barber's clippers should be substituted for the razor, shaving not being permissible. Manual epilation of all affected hairs by small forceps should be a daily procedure. Depilatory wax (see Hypertrichosis, page 972) is a good means of epilation when the hairs of the beard are sparse. Afterward the use of antiseptic ointments is advisable. Of these, calomel or ammoniated mercury ointment, 5 to 10 per cent; red sulphide of mercury, 1 per cent, with sulphur precipitate, 10 per cent in ointment form; quinine muriate, 2 per cent ointment; or solution of aluminum acetate applied as a wet dressing or in ointment form mixed with equal parts of anhydrous lanolin have given the best results. When the inflammation is acute, hot compresses or wet dressings of boric acid solution are beneficial. If the eruption does not respond to this type of treatment in the course of a month, it is desirable to begin the supplementary use of autogenous vaccines. These should be given three times a week in doses large enough to provoke redness and swelling about the site of the injection.

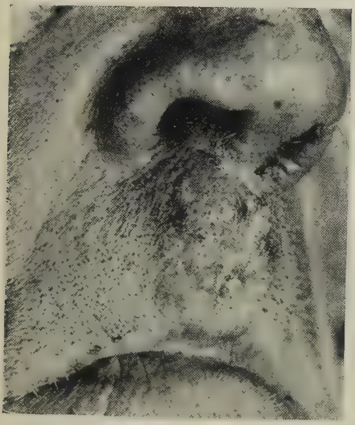

Fig. 339.—Sycosis vulgaris. Early patch in common location.

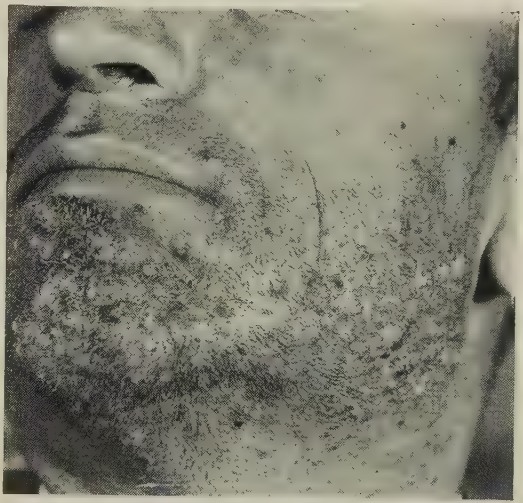

Fig. 340.—Involvement of the bearded region in sycosis vulgaris.

Roentgen Therapy.—This is a most valuable form of therapy to be used as an adjunct to the foregoing measures. When *x*-rays are used, the severity of the case is diminished, less external treatment is required, recurrences are less common, and the majority of patients can be cured in less than half the time otherwise necessary.

As a rule, good results can be secured by giving fractional doses. For patients not previously irradiated, $\frac{1}{4}$ E. D. at weekly intervals nearly always causes improvement. In patients not cured by eight or ten such treatments, the disease seems to acquire a tolerance for *x*-rays, so that after a time fractional exposures are of no benefit. In order to produce improvement in these stubborn types, the exposures must be increased so as to cause temporary epilation. This is effective in a great number of cases, but in others there are recurrences after temporary epilation, and the ingrowing hairs must be epilated again and again until eventually there is permanent alopecia. Even when permanent alopecia is established the disease may recur and continue in contiguous areas where short hairs remain.

In order to obtain uniform epilation it is necessary to have a precise conception of the physics of radiotherapy. The *bearded region,* morphologically, consists of many different convexities, planes, and angles which make difficult an equal distribution of dosage upon all of its parts. Either the surface must be subdivided into many small carefully shielded areas which can be exposed separately to the *x*-rays, or the anode-skin distance must be increased to such a point that minor irregularities of the surface under treatment have a negligible effect upon the angle of incidence of the radiation beam, and there is trivial loss of intensity at the periphery of the radiated field. The author prefers the latter method in which uniform dosage is obtained over the entire bearded region by direct treatment from six placements without overlapping. The following areas are marked off carefully with ink and shielded separately:

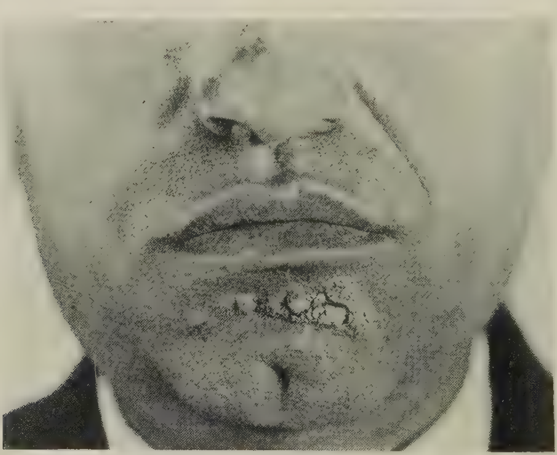

Fig. 341.—Vegetative lesion in sycosis vulgaris.

1. Surface of cheek from hairline to lower edge of mandible extending forward to corner of mouth;
2. Upper and lower lips and anterior portion of chin;
3. Lateral surface of neck;
4. Submental region and anterior aspect of neck;
5. Surface of opposite cheek;
6. Opposite lateral neck;
7. Upon angular surfaces, extra areas may be necessary. The surface of each cheek may require division into two areas.

The mucous membranes of the lips should be shielded, as well as the unaffected parts of the head and shoulders. In the treatment of the submental region and anterior surface of the neck, the head should be retroflexed, the shoulders being supported by a pillow over the edge of which the head falls backward.

This method differs from the Kienböck method in which four placements are used and overlapping is permitted. Overlapping is always an uncertain factor, especially on irregular surfaces, and epilation of the bearded region is far more difficult than epilation of the scalp. Although the described method has personal preference, the Kienböck method may be desired by some readers. This method was originated for the epilation of ringworm of the beard and is described in the chapter on Fungus Diseases, page 572, where there is also described the method of epilation by a combination of half doses each of thallium acetate and x-rays.

For epilation of the bearded region, *filtered radiation* is undoubtedly superior to unfiltered, because the margin between the epilation and erythema dose is greater. In the treatment of tinea capitis the longer exposure times and the possibility of brain injuries prevent its use, but on other body areas the preference for filtration for epilation is well established.

The dosage should be fractional. At ten-inch anode-skin distance, $\frac{1}{4}$ E. D. should be given through 3 mm. of aluminum at three-day intervals for a total of four treatments to each of the above areas without overlapping. One week following the date of the fourth exposure, a last or fifth is given, and two to three weeks subsequently the hair begins to fall out.

The epilation dose applied to the beard is very close to an erythema exposure. It should be the aim of the operator to avoid an erythema. With this point in mind, he should allow a rest interval of three weeks when changing from ordinary treatment to epilation. The technic and dosage given above usually cause epilation without erythema, although in addition considerable experience and personal skill are desirable.

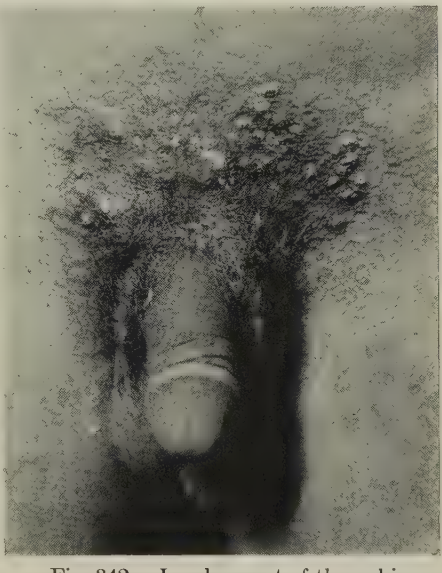

Fig. 342.—Involvement of the pubic region in sycosis vulgaris. (Courtesy of Dr. J. Gardner Hopkins.)

In instances where small areas are involved it, is not necessary to epilate the entire bearded region, but epilation of the affected patches with a wide margin about them is sufficient.

When *unfiltered radiation* is employed exactly the same technic is followed, but the dosage is $\frac{1}{4}$ E. D., given at the same intervals as when filtered.

In cases which recur after thorough temporary epilation, a cure can sometimes be obtained only by producing a permanent alopecia of the affected areas. When the patient has coarse, swarthy skin, this can often be accomplished without subsequent telangiectasia or wrinkling, although some dryness is invariably present. It is necessary for legal reasons to inform the patient of the possible hazards and obtain his consent to the risk involved. The annoyance and disfigurement to a patient who suffers from a recalcitrant form of sycosis vulgaris are so great that he will gladly acquiesce to the loss of his beard and possible minor radiation sequelae.

For permanent epilation, it is necessary first to produce a temporary defluvium by the same method which has been described. After the hair has fallen, its regrowth is prevented by the administration of $\frac{1}{2}$ E. D. of filtered radiation to all of the outlined areas at intervals of three weeks for four or five months. Permanent alopecia usually cures the affection, but, as stated, in isolated instances recurrences have been observed in adjacent areas where there are short hairs. A few patients have resisted all known methods of treatment.

During ordinary fractional treatment the *local applications* described for use after manual epilation may be made with perfect safety, and with marked benefit, but during the process of epilation by roentgen rays, it is advisable to discontinue all irritating local applications until the defluvium has occurred. During the interval between two weeks prior to the institution of roentgen epilation and the date of the defluvium, wet dressings of 3 per cent solution of aluminum acetate (Burow) are soothing and effective. After the defluvium, ammoniated mercury ointment and the other ointments mentioned for use after manual epilation in strengths rapidly increasing to maximum are advised in order to eliminate all infection before the hair regrows.

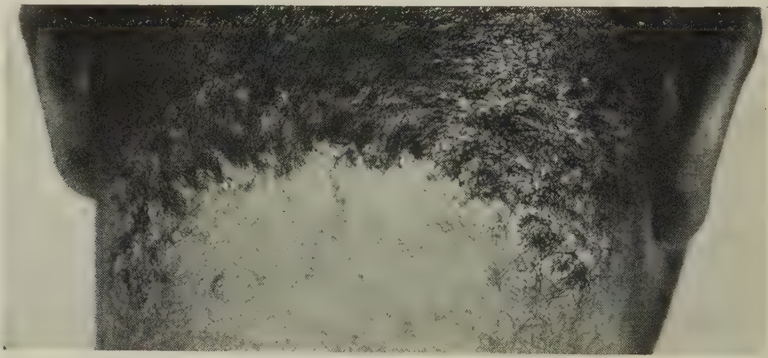

Fig. 343.—Lupoid sycosis of back of neck.

Rarely does sycosis vulgaris involve *other hairy surfaces* in addition to the bearded region. In order mentioned, the eyelashes, eyebrows, pubis, inner thighs, and axillae may be affected. The treatment of these areas by x-rays is much easier than the bearded region. Inasmuch as many of the patients so affected can be cured without epilation, ordinary fractional treatment should be tried for seven or eight weeks before it is considered. When epilation is undertaken, the radiation is carefully limited to the affected areas by shielding, and the defluvium is accomplished by a single epilation dose, preferably filtered. Of course, when the eyelashes are involved, x-rays are not used, but the epilation is manual, by forceps.

w-Ray, Ultraviolet, and Radium Therapy.—Little success is accorded w-rays and ultraviolet light in the treatment of sycosis. Although epilation can be accomplished by radium therapy, this method is rarely employed except on small patches. For epilation of the eyebrows the method has real convenience. A flat glazed applicator, preferably with a filtration of 0.5 mm. of lead or silver, gives good results. For half-strength applicators the epilation exposure with this filtration is four hours' contact. Pinch uses an unscreened exposure of an hour and a quarter to an hour and a half with a full-strength applicator. Du Casse produced a cure by radium in a case which had resisted roentgen therapy. The lesion was on the upper lip and of six years' duration, but such results have been rare in the author's experience, and there seems to be no legitimate reason to prefer radium to *x*-ray therapy in the general treatment of sycosis vulgaris until the whole problem of the optimum wavelength for epilation has been solved.

DERMATITIS PAPILLARIS CAPILLITII

Synonyms.—Acne keloid, sycosis framboesiformis, sycosis nuchae.

This is a persistent staphylococcus perifolliculitis of the back of the neck, associated with keloidal thickening and cicatrization. Often seborrheic plugs or comedones occlude the follicular orifices.

By far the best treatment is with *x*-rays, which not only reduces the fibrous thickening, but produces epilation of the infected hairs. Filtered *x*-rays in fractional exposures of $\frac{1}{3}$ E. D., given at ten-day intervals, are superior to other forms of treatment. Good results are also accomplished with unfiltered *x*-rays in the majority of cases, $\frac{1}{4}$ E. D. being given weekly or $\frac{3}{4}$ E. D. at intervals of three weeks.

Epilation may ensue from persistent *x*-ray treatment, and is desirable in recalcitrant cases. The patient should be informed of this possibility, and the hairy scalp not involved should be adequately protected from irradiation. Temporary epilation is not of serious consequence when limited to the diseased area. It should, however, be avoided in mild cases as much as possible, and be intentionally produced only when the affection is severe.

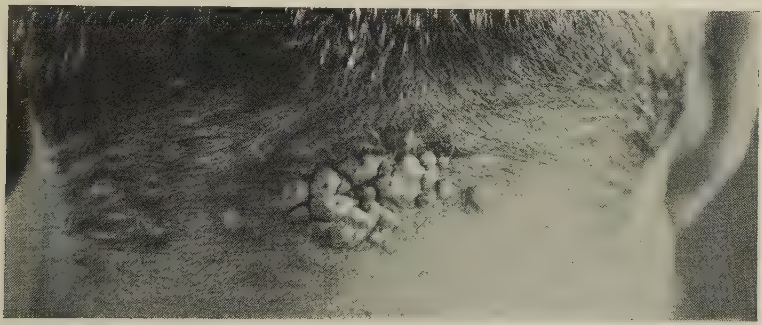

Fig. 344.—Keloidal masses in dermatitis papillaris capillitii.

Where the disease involves a large area on the lateral surfaces and the nape of the neck, it may be necessary to increase the anode-skin distance in order to cover the entire affection adequately. Even an increase of distance may not suffice to give uniform dosage when the lateral surfaces are extensively involved. In such instances the treatment should consist of exposures given separately to each side of the nape of the neck with overlapping. The unaffected areas should be carefully protected, and because of overlapping, the patient should be observed at each visit for signs of overdosage. When epilation has occurred, the irradiation should be discontinued for three to six months. During this rest interval air- or water-cooled ultraviolet light, given in erythema exposures, twice weekly, causes some benefit.

On small lesions radium may be used in the manner described for sycosis. Destructive reactions produce smooth supple hairless scars, and such intensities are necessary in many cases.

Local use of ammoniated mercury should be combined with treatment of the scalp for dandruff by resorcin lotions and ultraviolet light. Seborrheic plugs and comedones should be removed and small abscesses drained. The results of vaccine therapy are usually disappointing and internal treatment is useless.

FURUNCULOSIS

Synonyms.—Boil, furuncle.

A furuncle or boil is an acute round, tender, circumscribed staphylococcic inflammation, which generally ends in central suppuration. The lesions are brought about by irritation, pressure, friction, scratching, moisture, and warmth, especially in persons predisposed by anemia, alcoholism, constipation, diabetes, or other states of lowered resistance. Usually the lesions are spread by auto-inoculation, but at times may metastasize through the general circulation.

Treatment.—The general health should be improved and efforts should be made to increase the resistance of the individual to the infective microorganisms. Tonics, sulphur, yeast, light diet and catharsis, rest, sunshine and fresh air are generally recommended. In addition to these measures, staphylococcic vaccines or injections of colloidal manganese are valuable. The local treatment varies in accordance with the location, stage of development, and extent of the lesion.

In general the value of radiotherapy in the treatment of acute and chronic pyogenic infections, especially furunculosis, has not been commonly recognized. While radiation should always be used as an adjunct to other forms of therapy, it has a striking value when properly applied. It is a painless method, aborting early lesions, with prompt relief of discomfort and without scarring. Roentgen and ultraviolet therapy have specific indications, as will be described.

Incipient Lesions.—When the lesions are incipient and acutely inflammatory, a suberythema exposure of filtered *x*-rays hastens the localization and in small lesions may be abortive. One *x*-ray treatment usually suffices, rapidly relieving the pain and causing prompt involution. In the irradiation of a furuncle the surrounding area is included as such exposure seems to prevent the development of neighboring lesions. On hairy parts the dosage should be $\frac{1}{2}$ E. D., and on nonhairy parts it may be a little larger. Filtration through 3 mm. of aluminum is preferred by the author. The earlier an incipient lesion is treated, the more prompt is the involution and the greater the likelihood of a cure without suppuration. These benefits are of special advantage when parts of the face above the mouth are involved, because such infections must be handled with caution on account of the danger of thrombophlebitis and meningitis.

Well-directed ultraviolet treatment will in many cases cause the disappearance of a furuncle if applied in the early stage. At this time blistering exposures given to a wide margin about the lesion yield excellent results. Carbon or mercury arc lamps produce benefits that often equal those from filtered roentgen radiation, one treatment being generally sufficient. The exposure produces an intense congestion and apparently stimulates the local defence, so that frequently one treatment causes complete involution. The local action on the lesion is directly bactericidal, and there is an increased blood supply to the part, with an augmentation of the lymphocytes and phagocytes. After the treatment a dressing of ichthyol ointment is applied. Other abortive methods of treatment such as carbolization and electrodesiccation have given relatively little satisfaction in my hands.

When the lesions are incipient and acutely inflamed, incision should be strictly avoided. Hot poultices should be applied every few hours and the part should be covered with a wet dressing of alcohol or liquor alumini subacetatis; ammoniated mercury ointment, or 10 per cent ichthyol in basilicon ointment (Ceratum Resinae, U. S. P.) or 4 per cent phenol in unguentum diachylon. These measures should be continued until the pain and redness have subsided and the process has become localized and inactive with frank pus.

Localized Inactive Lesion.—When the furuncle has become localized and inactive and shows definite fluctuation, free incision with drainage should be executed without delay. Following incision, healing is hastened by distance radiation with ultraviolet light, producing first degree reactions. The treatments should be given every alternate day.

Recurrent or Chronic Type.—In recurrent or chronic furunculosis confined to localized areas, fractional unfiltered or filtered x-rays often stop the development of further lesions and relieve conditions that have failed to respond to surgical measures. Filtered x-rays seem more efficacious than unfiltered for this purpose, but good results are accomplished by both methods. The dosage may be $\frac{1}{4}$ E. D. at weekly intervals, or $\frac{3}{4}$ E. D. at one sitting, without further exposures. An erythema should be studiously avoided although in stubborn cases an epilation is justifiable and beneficial.

On recurrent furunculosis of the scalp, x-rays may be used with caution. Spectacular results sometimes have followed the administration of one fractional treatment. When the disease is recurrent on the back of the neck, no treatment equals filtered x-rays. Accurate arrangement of the patient and focusing are extremely important in this difficult location if the best result is to be expected. In recurrences of the disease on the scalp and the back of the neck, it is imperative to keep the scalp free from dandruff by local antiseptics, as noted in the Eczema chapter, page 413. Ultraviolet radiation from a distance is useful for this pnrpose and simultaneously exerts a direct beneficial influence upon the furunculosis. In axillary cases, rest in bed with the arm away from the body is a measure of some importance. In treating the buttocks, the testicles should be screened by lead. Affections recurring on the vulva or perineum should be treated by fractional filtered roentgen rays in either the lithotomy or knee-chest position according to the best exposure. The parts should be kept scrupulously clean, and free from the irritation of discharges, clothing, or walking.

Generalized ultraviolet light baths for surface asepsis and tonic effect should be given in all cases of recurrent furunculosis. When lesions are widely disseminated on distant parts of the body, considerable reliance must be placed upon these treatments. The exposures should follow the technic given in Chapter IX, page 223. Reactions more violent than to cause a slight peeling should be avoided.

Ultraviolet light baths also give striking results in the treatment of multiple furunculosis in infancy. Usually this group of cases is treated surgically, but in my hands better results have been attained by limiting incision to a minimum and by relying to a large extent upon actinotherapy and the use of local antiseptics, especially 3 per cent ammoniated mercury ointment.

CARBUNCULOSIS

Synonyms.—Anthrax benigna, carbuncle.

Carbuncles are circumscribed inflammations of the skin and subcutaneous tissue with a separation and sloughing in multiple points apparent on the surface. The Staphylococcus aureus is usually the etiologic factor. Carbuncles may be of the superficial or deep type.[1] The common superficial variety is characterized by pronounced cutaneous redness, multiple skin perforations in an early stage and, after sloughing, does not leave a very deep excavation. In the deep type, the lesion seems brawny and fixed like a malignant tumor; and there are late perforation and sloughing with deep crater formation.

Superficial Type.—Roentgen therapy is almost a specific in lesions of the superficial type, causing prompt relief of pain, softening, and evacuation of pus and rapid recovery. In lesions on the nose and the upper parts of the face[2] this method has special importance. Numerous authors have reported striking results from roentgen therapy of carbuncles. In general the indications, technic, and dosage are the same as described for the incipient stages of furunculosis in the preceding pages.

Carp has compared the following four different methods of treating carbuncles: by roentgen ray, by surgery, by conservative therapy, and by autogenous blood circuminjection. His work is based on a study of 153 patients, nondiabetic and diabetic, with carbuncles, admitted to the Presbyterian Hospital, New York, in the past ten years.

The statements concerning dressings and the local and generalized exposures of ultraviolet radiation in the treatment of incipient furunculosis apply equally well to the superficial type of carbuncle. Both roentgen and ultraviolet therapy are usually dynamic in causing rapid regression, relief of pain, and evacuation of the detritus.

Deep Type.—In the deep type of carbuncle, radiation therapy is invariably of some benefit, preference being given to filtered x-rays. However, the results are not so good as in the superficial types, and one should beware of toying with radiation therapy when surgical procedures are definitely indicated by deep spreading or severe general intoxication, especially in patients who have low resistance. Extensive crucial incision going well beyond the inflamed margin, elevation of the flaps, and trimming away of necrotic material should be done under gas and oxygen anesthesia without delay, the cavity being packed with gauze soaked in Schlumsky's solution (phenol, 30 per cent; camphor, 60 per cent; alcohol, 10 per cent). Healing is expedited by local and general actinotherapy.

The electric cautery, electrocoagulation, and the electrothermic cutting current are recommended as superior to the scalpel by different advocates. Willmoth described electrocoagulation treatment which may be done under local anesthesia except in severe cases, which require ether. A full-strength hyoscine, morphine or cactine tablet two and one half hours before operation, augmented by a half-strength tablet of the same drug thirty minutes preceding the operation, is effective. The indifferent electrode is covered with a towel wet with normal saline solution to make a good contact, and is firmly bandaged

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[1] Phillips, Sidney: A Dissertation Upon Carbuncles, Lancet, 1: 61–65, Jan. 8, 1921.

[2] Roeder, C. A.: Ligation of the Angular Vein in Infections of the Upper Lip, J. A. M. A., 90: 272–273, Jan. 28, 1928.

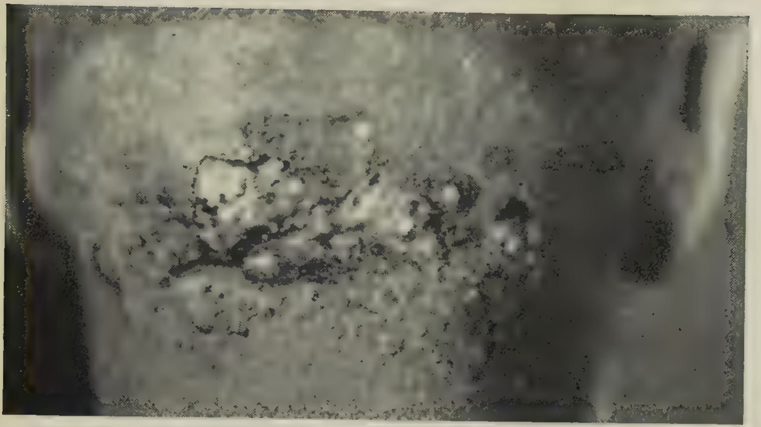

Fig. 345.—Carbuncle already showing signs of localizing and softening four days after *x*-ray treatment. (Courtesy of Dr. R. W. Lewis.)

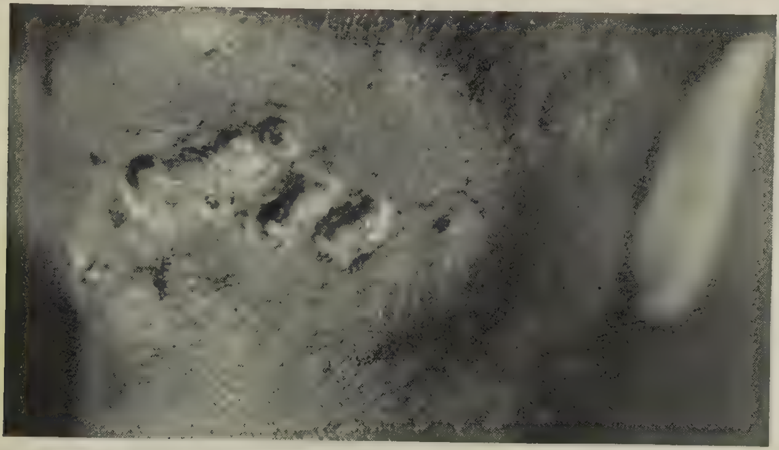

Fig. 346.—Same lesion ten days after *x*-ray treatment, now completely broken down and draining freely through multiple sinuses. (Courtesy of Dr. R. W. Lewis.)

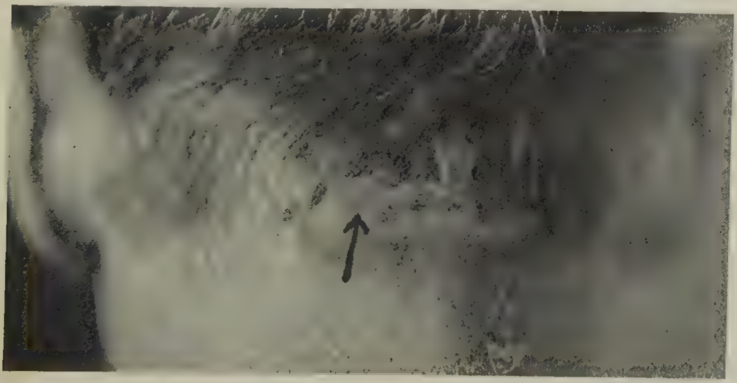

Fig. 347.—Same patient three months after *x*-ray treatment. (Courtesy of Dr. R. W. Lewis.)

against the skin of the abdomen, the patient being in a prone position. Where no general anesthesia is used the active electrode is applied with a very light current which passes around the carbuncle in a circular manner for three to five minutes, during which time the spark is gradually increased. This causes the entire area to become numb. The current is then increased and the needle is pushed to the depth of the infected tissue, where it is allowed to remain. When the tissues become white, the needle is removed and inserted into an adjoining area to produce a similar effect. By repeating this procedure the entire pathologic condition is destroyed in a few minutes. The coagulated tissue is removed by a large curet or by the electrothermic cutting current, leaving a clean base to which a wet dressing of liquor alumini subacetatis, diluted 1 to 10 vols., is applied. Bleeding points are controlled by plunging the active electrode directly into the vessel or by grasping the vessel with forceps and applying the active electrode to the forceps near the vessel. Pain is not experienced following the treatment because the small terminal nerve endings have been destroyed by the current. Healing may be expedited by the use of ultraviolet therapy, leaving a minimum amount of scarring.

IMPETIGO CONTAGIOSA

Synonyms.—Impetigo vulgaris, streptococcic impetigo, phlyctenular impetigo.

This is a superficial staphylococcus or streptococcus inflammation of the skin characterized by discrete thin-walled vesicles and bullae which rapidly become pustular and dry, forming loosely adherent golden crusts. Children are more susceptible than adults, and the face is the site of predilection. The ears, neck, and hands are also frequent locations. In adult males it is one of the diseases called "barber's itch" by the laity.

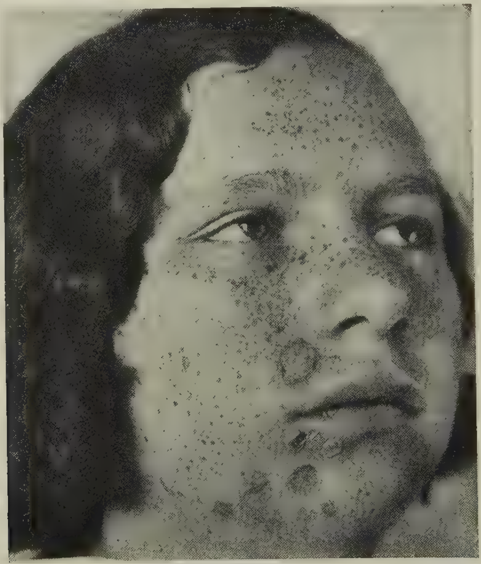

Fig. 348.—Circinate lesions of impetigo contagiosa of bullous type.

Impetigo contagiosa is one of the common skin diseases. It begins with vesicles or blebs that may simulate herpes simplex, and these rapidly rupture, leaving a spot denuded of epidermis and extremely exudative. The discharge is thin and straw colored, and when dry forms yellowish, loosely stratified crusts with accumulate layer upon layer until they are thick and friable. The crusts usually can be readily removed after being soaked with peroxide of hydrogen and olive oil. After removal, the surface beneath them is seen to be smooth, red and moist, although at times its real appearance is not evident until a purulent sticky exudate has been wiped off. A few minutes after the surface has been cleansed and dried, fresh exudate collects in drops on the spot. This exudate, being spread by the fingers, towels, or household utensils, forms the chief source of auto-inoculation, and of contagion to others. Common sources of infection for children are pets, dirty fingernails, and other children in schools; for adults, barber shops, beauty parlors, Turkish baths, swimming pools, and children. Ill health and secondary anemia are predisposing causes. Impetigo is often secondary to pediculosis capitis, scabies, herpes simplex, insect bites, poison ivy, eczema, and other exudative pustular or itching skin diseases. In camps, hospitals, and boarding schools the disease may be disseminated by the laundry, and employees should be examined for furunculosis, paronychia, pediculosis, acne, and other possible sources of contamination.

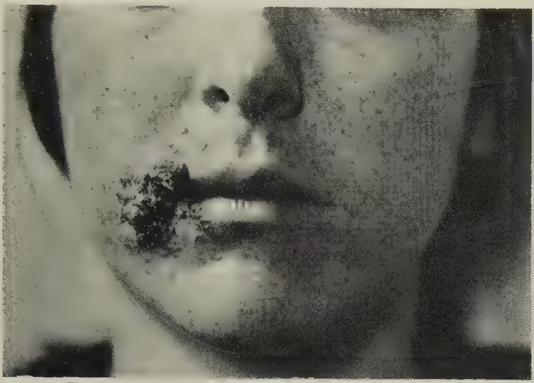

Fig. 349.—Impetigo contagiosa. Characteristic thick crusts.

Varieties.—Several forms of impetigo are recognized, although the application of the term is more limited than it was formerly. After the bullae rupture they leave circinate, raw or crusted lesions, and in this stage the term "impetigo circinata" is sometimes used. When bullae are a prominent feature of the eruption, the designation "impetigo bullosa" is given to the affection. Impetigo gyrata denotes a form in which the lesions spread peripherally and clear in the center, becoming large circles which by fusion produce gyrate patterns. Pemphigus neonatorum, furfuraceous impetigo, and impetigo of Bockhart are varieties described separately.

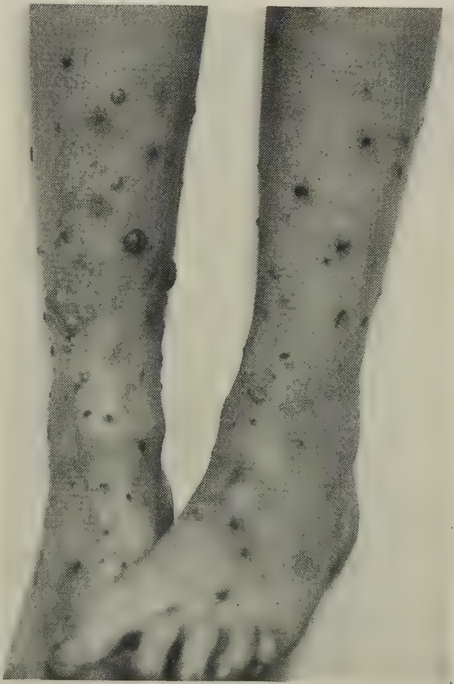

Fig. 350.—Bullous impetigo. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Differential Diagnosis.—Impetigo may simulate several diseases. The circinate patches are frequently mistaken for ringworm, but clinically are essentially different, being superficial, very exudative lesions covered by thick yellowish crusts. which do not resemble the scaling patches with slight peripheral vesiculation seen in tinea circinata. Impetigo may be mistaken for poison ivy, but is more crusted and pustular, and more liable to involve the nostrils, the corners of the mouth, and the ears, and has not associated with it the puffing of the eyelids and the linear lesions that are so often present in poison ivy. Ringed lesions on the face due to syphilis are an uncommon manifestation of the disease, being encountered most often in negroes. Such lesions are not moist; there are no vesicles, bullae, or crusts. They are dry and occasionally slightly scaly, and the rings are composed of fused papules,

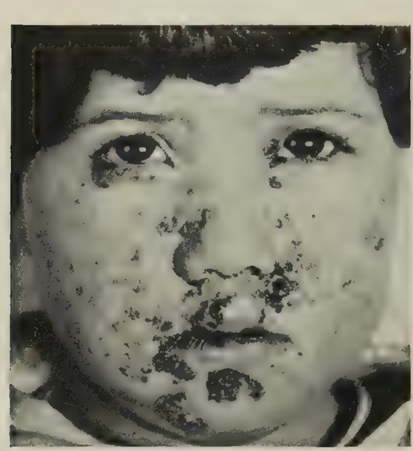

Fig. 351.—Impetigo contagiosa in a child.

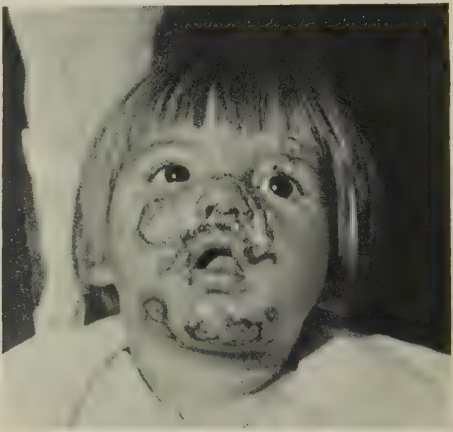

Fig. 352.—Circinate type of impetigo contagiosa in a little child. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

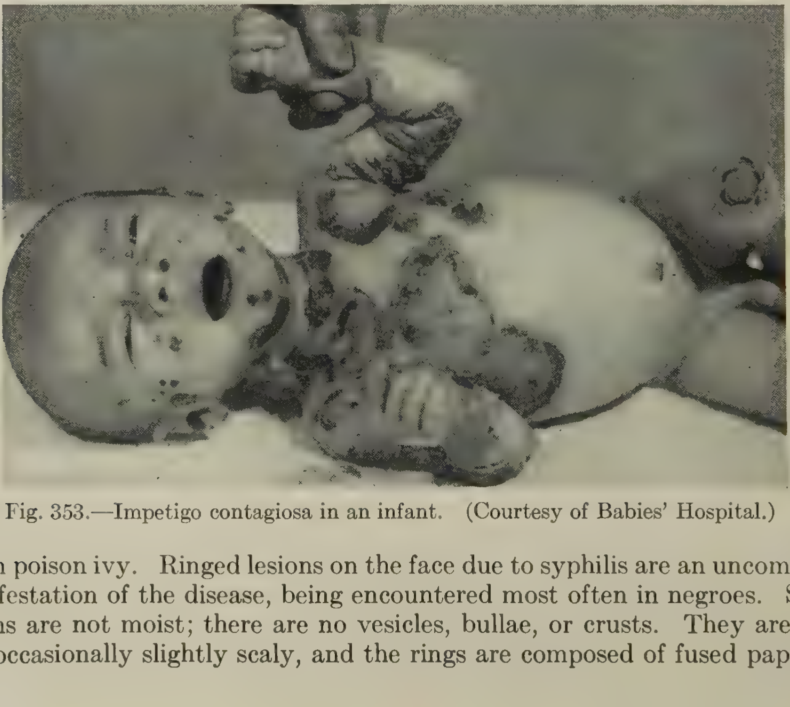

Fig. 353.—Impetigo contagiosa in an infant. (Courtesy of Babies' Hospital.)

which feel like a cord under the palpating finger. Impetigo may be confused with pustular eczema. In the latter the patches are larger, pruritic, and less superficial, as well as less numerous. In varicella the lesions are small, widely distributed, discrete vesicles and usually present in the mouth, a site rarely involved by impetigo. In ecthyma the lesions are larger, deeper, and more inflamed than in impetigo and are covered with a hard, bulky crust.

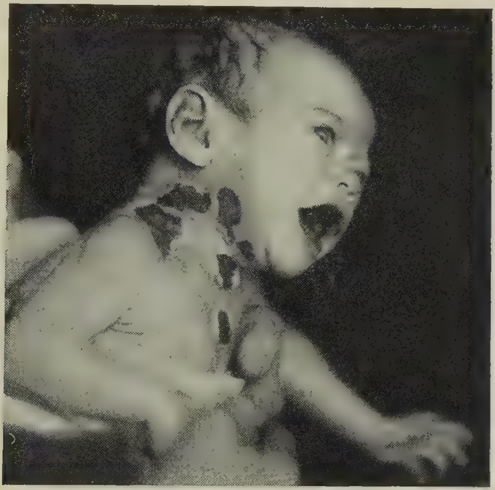

Fig. 354.—Bullous impetigo (pemphigus neonatorum) in an infant. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Treatment.—Strict cleanliness and the application of a 3 to 10 per cent ammoniated mercury ointment is the classical effective treatment. It is customary to begin with a 3 or 5 per cent strength, and to increase to a 10 per cent strength only if there is no improvement after five to seven days. Occasionally wet dressings of liquor alumini acetatis (Burow's) are of distinct value. Daily sponging of the lesions with peroxide of hydrogen, removal of the crusts by forceps after having been softened with olive oil, and the application of bandages over the dressings expedite the cure. In cases resistant to these measures, benefit is sometimes attained by painting the lesions with a 5 per cent solution of silver nitrate.

In stubborn cases $\frac{1}{4}$ or $\frac{1}{2}$ E. D. of unfiltered *x*-rays frequently produces noteworthy improvement. In my experience *x*-ray treatment has proved particularly useful in adult males where the affection is recalcitrant because of the beard, but ultraviolet light has been of no local value although recommended by Saidman, Russell, and others.

SUPERFICIAL PUSTULAR PERIFOLLICULITIS (IMPETIGO OF BOCKHART)

This is a staphylococcus perifolliculitis with small pustules at the orifices of the pilosebaceous glands, favorite locations being the extremities and scalp.

Treatment.—On the glabrous skin, fractional unfiltered *x*-ray treatment of $\frac{1}{4}$ E. D. at weekly intervals causes rapid improvement. Three or four exposures usually suffice to cure the disease. The affected areas are thoroughly cleansed morning and night with tincture of green soap and warm water followed by hydrogen peroxide and are then covered with 5 per cent ammoniated mercury ointment, and bandaged.

Fractional x-ray treatment is also very effective in this disease on the scalp. In severe cases it is necessary to effect a defluvium, but the average eruption is cured by fractional unfiltered treatments of $\frac{1}{4}$ E. D. given weekly for a period of three weeks. This amount is usually below that required for epilation. The scalp is divided into five areas, as in the treatment of tinea capitis, and each area is given $\frac{1}{4}$ E. D. with overlapping allowed, all five exposures being repeated at each treatment. In conjunction with the x-ray therapy the scalp hair should be cut close and the scalp cleansed daily with benzine and hydrogen peroxide, followed by a brisk shampoo. It is then painted with 1 per cent tincture of iodine, or thickly covered with 5 per cent ammoniated mercury ointment.

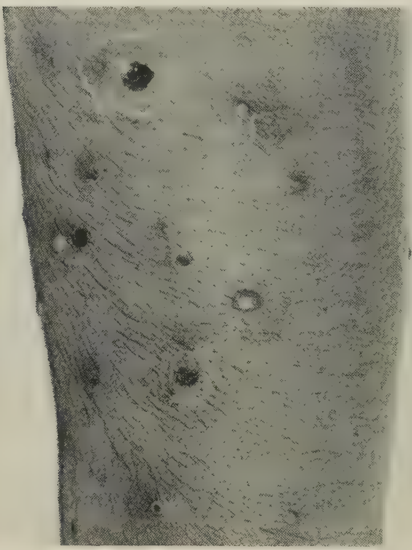
Fig. 355.—Impetigo of Bockhart.

PERLÈCHE

This is a subacute or chronic affection of the lips characterized by fissures, desquamation, and maceration caused by eczema, monilia or pyogenic cocci. It occurs a little more frequently in children than in adults. One fourth E. D., unfiltered, given at weekly intervals invariably causes rapid improvement. In conjunction, 2 per cent ammoniated mercury ointment and compound tincture of benzoin applied to the lips morning and night are useful medications.

FURFURACEOUS IMPETIGO

Synonyms.—Impetigo pityroides, scaly impetigo.

This affection is characterized by discrete, fine desquamative nummular patches on the cheeks. It is most frequent in children, where it is to be distinguished from infantile eczema. The lesions respond to the local remedies used for impetigo. Stubborn cases respond to one or two doses of subfractional unfiltered roentgen radiation, and to tonic treatment with generalized exposures of ultraviolet light.

IMPETIGO OF THE NEWBORN

Synonym.—Pemphigus neonatorum.

This is a variety of bullous impetigo which occurs in newborn infants. There is no association between this disease and pemphigus. It is to be differentiated from the bullous eruption of congenital syphilis, which is practically limited to the palms and soles, and is generally accompanied by other manifestations of the disease. Pemphigus neonatorum is highly infectious. Cases should be handled accordingly, and the patients treated by mildly antiseptic baths containing boric acid, or solution of aluminum acetate (1 : 20). Bullae should be opened and areas covered with 1 or 2 per cent ammoniated mercury ointment. Generalized ultraviolet light treatments, in doses below an erythema—for thirty seconds at 30 inches distance daily—are of value.

DERMATITIS REPENS

Synonym.—Acrodermatitis continua.

Dermatitis repens is an inflammatory disease of the skin which is probably caused by the Staphylococcus aureus. It nearly always begins following some trivial injury. Within a few hours or days vesicles or bullae appear at the site of injury. They rupture and the elevated epidermis is cast off, leaving a red surface, from which a clear or slightly turbid fluid oozes. About the denuded area there remains an irregular ring of loose, sodden epidermis. According to Radcliffe-Crocker, extension sometimes takes place by the further detachment of the epidermis as the result of continued exudation, or there may be fresh vesicles or small bullae just beyond the border, which break down and add another denuded area to the original adjacent one. Although new foci may thus be formed locally, the disease seldom becomes generalized or spreads to distant parts. According to Audry, the lesions are actually situated in the epidermis, leading to the desquamation of the epidermal layers which form their roof and leaving surfaces eroded but never ulcerated—purulent phlyctenae, and not pustules. Crusted, eczematoid, and psoriasiform lesions may be observed and there may be moderate itching.

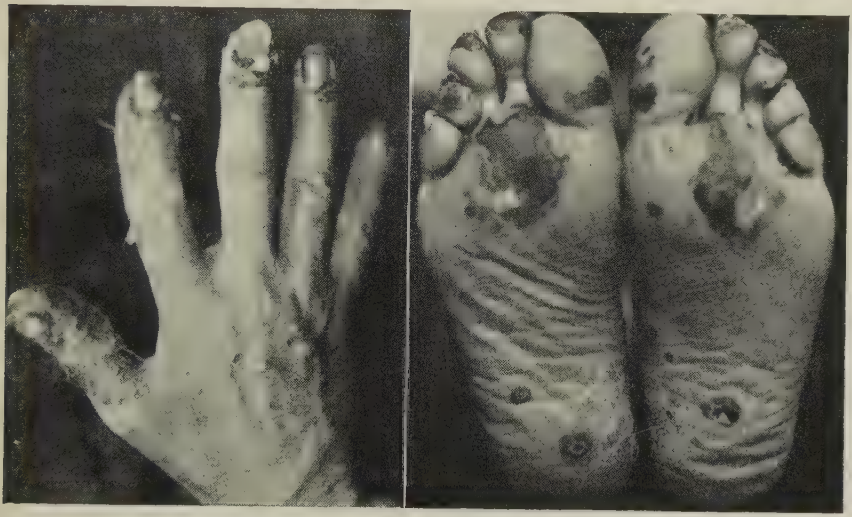

Fig. 356. Fig. 357.

Figs. 356, 357.—Dermatitis repens. Generalized type which followed a whitlow of the right thumb. (Courtesy of Dr. H. W. Barber, London, England.)

The parts involved are the hands and feet and occasionally, as pointed out by Barber, the mucous membranes, particularly of the mouth. The condition also often affects the nails, causing an ordinary paronychia. The process generally remains limited to these parts; the generalized variety is rare. Invasion of the mucous membranes may occur even when the infection of the skin is localized. White circular plaques surrounded by inflammatory areolae are found on the tongue, and may form a diphtheroid membrane; fissures have been described. Although the inflammatory condition in the mouth is superficial, it is painful. In the generalized cases described by Barber there was gross sepsis in the mouth, and he calls attention to the importance of focal infections which may lower the resistance of the skin to staphylococci.

Dermatitis repens must be differentiated from dermatophytosis and infectious eczematoid dermatitis. Although it is related to the latter etiologically, the eruptions are different. In dermatitis repens it is not a question of a generalized epidermal sensitization to staphylococci, but of a localized invasion of the skin by the infecting organisms, resulting in the formation *in situ* of a distinctive subcorneal lesion of the abscess type rather than the production of intra-epidermic vesicles characteristic of eczematoid eruptions. The course of the disease is chronic and a favorable outcome is hastened by the removal of focal infections. At times the disease is extremely rebellious and it may be fatal. Local antiseptic dressings are generally of little value. Among the various remedies suggested are 1 per cent solution of resorcin in a saturated solution of boric acid; 10 per cent aqueous solution of potassium permanganate; a solution of salicylic acid (2 per cent), tannic acid (10 per cent) in alcohol; and 1 per cent solution of neutral acriflavine in physiologic salt solution. *x*-Ray treatment and autogenous vaccine injections have been of benefit in some cases and seem the most satisfactory of the various therapeutic agents recommended.

PYOGENIC PARONYCHIA

The most common causes of infections about the nails are pyogenic cocci and fungi. The former cause acute and chronic purulent, tender, edematous swellings of the tissues around the nail, sometimes leading to malformation and shedding of it. Diseases of the nails caused by fungi are described separately. Differential diagnosis between the two affections is often difficult and sometimes can be made only by cultures and prolonged study. As a rule, in paronychia due to cocci a drop of pus can be expressed by firm pressure, and the nails are simply ridged or misshapen; whereas in onychomycosis they are usually also thickened and everted, particularly at the free margins where there is a collection of crusts.

Treatment consists in rest of the part, protection from trauma, and the continuous application of antiseptic lotions or ointments. Acute cases often require incision and drainage, but chronic cases are likely to respond to the simple measures suggested above, combined with *x*-ray therapy.

Roentgen treatment should be by fractional doses of unfiltered or lightly filtered radiation, given weekly. Exposures should be limited to the affected fingers with careful shielding of the proximal phalanges. If definite improvement is not noticed after five or six treatments, it is best to discontinue the *x*-ray treatment and to treat the lesion surgically.

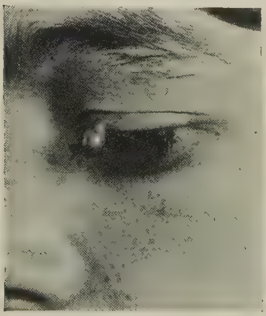

Fig. 358.—Granuloma pyogenicum of the upper eyelid.

GRANULOMA PYOGENICUM

Synonyms.—Botryomycosis hominis, septic granuloma.

These are small pedunculated raspberry-like, neoplastic vegetations of exuberant granulation tissue, which are secondary to infections by the pyogenic cocci. Microscopically, they show numberless newly formed blood vessels and young connective tissue with more or less lymphocytic and plasma-cell infiltration. The term "granuloma pyogenicum" is restricted by some dermatologists to the more purulent types, whereas those showing little pus are designated "granuloma telangiectaticum."

Theoretically, radiation therapy should be almost a specific for this disease, but in practice a cure is so rapidly and easily obtained by other methods that radiotherapy is generally superfluous. However, in lesions larger than 2 cm. in diameter, preliminary radiation with 1 E. D., unfiltered, may be warranted before other treatment is undertaken.

Any destructive sterilizing procedure gives a rapid cure. The author favors electrical cauterization or electrodesiccation under novocaine anesthesia, followed by strict local asepsis, which is accomplished by a dressing of ammoniated mercury ointment, or wet dressings of acriflavine. Cipatte and Charpy cleared up one case by an intensive dose of ultraviolet light.

DERMATITIS VEGETANS

This condition, although a clinical entity, is not of itself a disease, but arises upon the lesions of other disorders due to secondary contamination with staphylococci. It is characterized by exuberant granulation tissue which forms moist vegetations, dark-red in color. They are extremely vascular and often purulent or crusted. They develop most frequently upon patches of eczema or ringworm and occur in any region, but most often in the axillae, groins, and on the scalp.

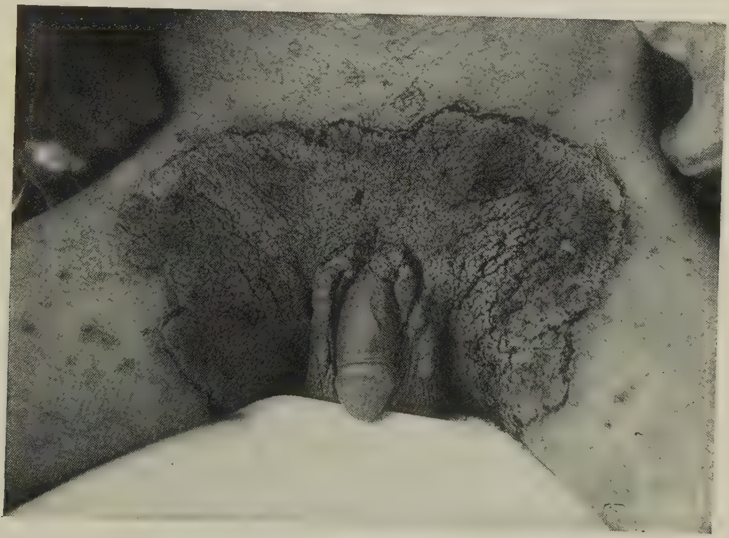

Fig. 359.—Dermatitis vegetans. (Courtesy of Dr. A. Benson Cannon.)

The treatment consists of wet dressings with acriflavine solution, 1 : 1000 in normal saline, or other antiseptic solutions. At times x-ray treatment causes prompt involution. Some cases are resistant to these measures and are best handled with the actual cautery.

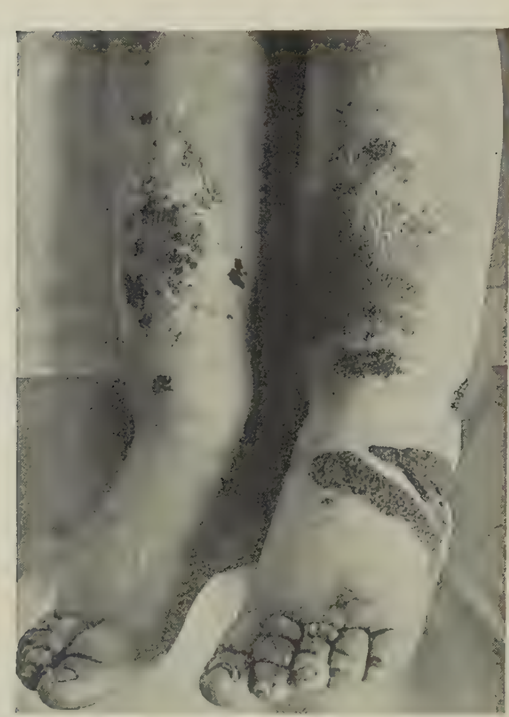

Fig. 360.—Dermatitis vegetans. (Courtesy of Dr. A. Benson Cannon.)

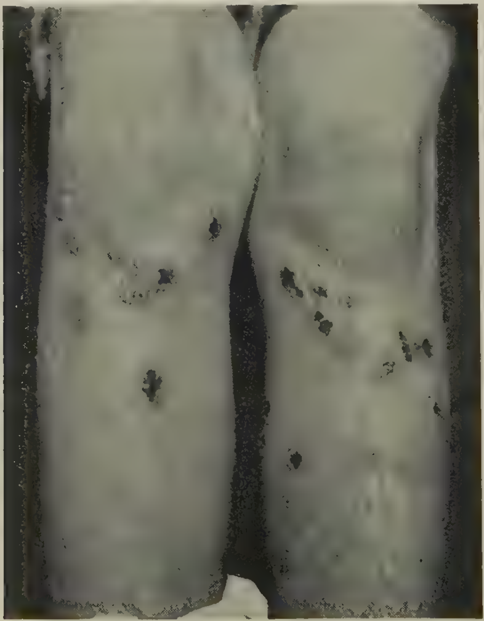

Fig. 361.—Ecthyma. (Courtesy of Dr. Lloyd W. Ketron.)

ECTHYMA

Ecthyma is an ulcerative type of streptococcus dermatitis usually affecting the legs, being similar to impetigo but more deeply situated. The disease begins with a vesicle or a vesicopustule, which enlarges and in a few days is thickly crusted. As the crust dries, it hardens and becomes adherent at the edges. When it is removed there is found a superficial saucer-shaped ulcer with a raw base and elevated edges. The lesions are infectious and auto-inoculable. They tend to heal after a few weeks, with slight scar formation, but rarely may proceed to gangrene when the resistance is low. In fact, a debilitated condition and illness precede the onset of ecthyma in most cases and should be considered predisposing causes.

Treatments by ultraviolet light stimulate healing and stop the development of new lesions. First degree erythema exposures from a distance should be given to the affected areas daily or every other day for several weeks, and this local treatment should be accompanied by generalized exposures for tonic effect.

x-Ray treatment parallels ultraviolet therapy in the results obtained. Filtration is preferable. Fractional filtered radiation consisting of $\frac{1}{5}$ E. D. at weekly intervals usually gives excellent results in four or five exposures.

During treatment the legs should be kept in an elevated position and rested as much as possible, and local antiseptics applied in the form of wet dressings or ointments. Focal infections should be eliminated and treatment by tonics and vaccines instituted.

ERYSIPELAS

Synonyms.—St. Anthony's fire, ignis sacer.

Erysipelas is an acute streptococcus infection of the skin and subcutaneous tissues, characterized by local redness, heat, and swelling, and a raised indurated border. The onset is usually preceded by prodromal symptoms of malaise for several hours, accompanied by severe constitutional reaction with chills, high fever, headache, vomiting, and articular pains. The temperature rises suddenly to 103 to 106 F. and the pulse is rapid, being due to a toxemia, which also causes severe prostration. The leukocytes are increased to 20,000 to 40,000 and in the differential count the polymorphonuclears to 80 to 95 per cent. This toxemia is due to the toxins of the Streptococcus erysipelatis which invades the local lymphatics. Extension of the disease, as well as the constitutional symptoms and even individual susceptibility to erysipelas, are controlled in a large measure by the amount of specific antitoxin available in the tissues and the blood stream to repel the infection.

The skin lesions may vary from transient hyperemia followed by slight desquamation to intense inflammations with vesiculation and phlegmon. The eruption begins at any one point as an erythematous patch and spreads by peripheral extension, usually tending to subside in one place as it progresses to another. In the early stages the affected skin is scarlet, hot to the touch, brawny, and swollen. A distinctive feature of the inflammation is the advancing edge of the patch. This is raised, sharply demarcated and feels like a wall to the palpating finger.

Course.—The first attack of the disease is usually the most severe. There may be no other attacks; in some cases, however, annual recurrences are common, especially in the spring months; in others, recurrences are very frequent, at intervals of only a few weeks or a month. Generally they are due to reinfection at a time of lowered resistance, with a paucity of antitoxin; but when frequent they are reactions to the toxin elaborated by the streptococcus which is constantly harbored in some focus of infection; and they are governed almost entirely by the quantity of antitoxin available to the tissues.

In typical cases the course of the disease is characterized by remittent fever, chills, vomiting, headache, and anorexia, all of which tend to subside in a few days or a week. During this period the cutaneous inflammation spreads, showing the distinctive border, while fading in the older areas, where the color becomes brownish and the epidermis desquamates. For long periods after resolution there may be local hyperesthesia, alopecia, impaired capillary circulation, thrombophlebitis, or cutaneous telangiectases.

In other cases the affected skin is the site of vesicles or bullae which contain seropurulent fluid. The bullous variety is an uncommon and severe form of the disease and may result in local gangrene. In these cases and in other severe instances of the disease, there may occur degenerative changes in the viscera due to the action of the toxin; vascular accidents due to emboli; serous inflammations of the meninges, pleura, peritoneum and synovial membranes; exhaustion; bronchopneumonia; septicemia, and death. Such eventualities are more common following operations in elderly persons and in infants.

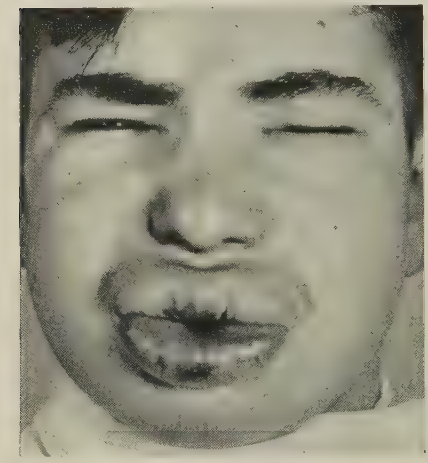

Fig. 362.—Chronic recurrent erysipelas of the lips.

Although any region on the skin may be the site of the disease, apart from the occurrence in postoperative cases, the face is the most frequent. The inflammation generally begins on the cheek near the nose or in front of the lobe of the ear and spreads upward over the scalp, although the hairline seems in some instances to act as a barrier against further extension. In severe cases the head may be tremendously swollen and distorted, particularly the ears, and there is an associated delirium. Constant recurrences on areas where there are loose tissues lead to a local persistent lymphedema (solid edema, elephantiasis nostras), which must be differentiated from lymphangioma and chronic lymphedema, from neoplasms, syphilis, filariasis, and tuberculous lymphangitis. The milder attacks are liable to be inaccurately diagnosed, being called eczema or rosacea, as they may produce little or no constitutional reaction, and only minor degrees of erythema or swelling.

Predisposing causes are operative wounds, fissures in the nares, fissures under the lobes of the ears, fissures of the anus, and between or under the toes, usually the little toe. Any inflammation of the skin, especially if exudative or ulcerative, may provide an entrance for the causative streptococcus. Often slight abrasions or scratches, accidental scalp wounds, unclean tying of the umbilical cord, vaccination, and chronic leg ulcers lead to the disease.

Diagnosis.—Recognition of the disease is generally not difficult. It may be confused with dermatitis venenata, acute erythematous eczema, and with angioneurotic edema, in each of which, however, fever is absent; with lymphangitis due to syphilis or to tuberculosis, which are also usually afebrile and run a protracted course; and with scarlatina, in which there is a widespread punctate erythema, never localized and edematous as in erysipelas.

Treatment.—The patient should be kept in bed, with an ice-cap applied, and should be given calomel or castor oil, aspirin, and a fluid diet, a quantity up to 3000 cc. or more a day being prescribed for adults. If the vomiting prevents retention of anything in the stomach, rectal injections of 8 ounces of water, containing two teaspoonfuls of citrocarbonate, may be given every three or four hours. The first injection should be preceded by a hot soap-suds enema. Other symptomatic treatment for the fever, intoxication, and discomfort should be given, and in elderly patients measures should be taken to avoid bronchopneumonia, cardiac failure, and other complications.

Innumerable local medications of doubtful value have been suggested to control the spreading of the disease. I have found iced compresses or talcum powder as good as any other application. The more common of the local remedies, however, will be mentioned: Ichthyol, pure, 30 per cent aqueous solution, or 25 per cent in vaselin, is widely recommended. Solutions of phenol, iodine, silver nitrate, mercurochrome–220 soluble, or tannic acid have been variously used in attempts to stop the spreading of the disease, but frequently do more harm than good on account of their irritating qualities. Continuous wet dressings of boric acid solution, alcohol, magnesium sulphate, aluminum acetate, or lead subacetate are at first soothing, but after a few hours cause discomfort. Blebs should be opened, crusts removed, abscesses drained, and such other surgical treatment as indicated should be given.

Since the advent of effective erysipelas antitoxic sera,[1] all other methods of treatment in the acute stages of this disease have become of secondary importance; and likewise injections of Streptococcus erysipelatis toxin are a specific method for the prevention of recurrences and the reduction of persistent lymphedema in cases of chronic recurrent erysipelas. In these cases (elephantiasis nostras) careful search should be made for streptococcus focal infections in the sinuses, teeth, and tonsils, as the micro-organisms may be absent in the skin lesions, which are apparently allergic.[2] Where the disease occurs on the lower extremities, infections of the toenails or anal fissures or streptococcus infections within the bowel should be treated. Stool vaccines are sometimes of benefit in the latter group of cases, but better results are gained from the injections of toxin from streptococci recovered from the stool.

The results of antitoxin treatment depend upon the specificity of the preparation used for the causative streptococcus in the individual case. Preferably the antitoxin should be polyvalent and should be given early in the course of the disease, after the patient's sensitization to it has been tested by the introduction of 1/10 cc. intradermally on the forearm. If no wheal occurs about this in twenty minutes, a hypodermic injection of 0.5 cc. is given and if no local or general disturbance has occurred, at the end of another twenty minutes, the entire dose—usually 20 cc.—is introduced intramuscularly, and in severe cases another 20 cc. in addition, intravenously without delay. After the injection there may be a chill and a sharp rise in temperature, followed by a sudden drop to normal or slightly above. Another intramuscular dose should be given the following day, which usually suffices. If there is not a decided drop in temperature within twenty-four hours after the first injections, it is presumable that the antitoxin did not possess the specific antibodies, and the injections should be repeated, another make of erysipelas antitoxin being used.

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[1] Birkhaug, K. E.: Erysipelas: Observations on the Etiology and Treatment with Erysipelas Antistreptococcic Serum, J. A. M. A., 86: 1411–1417, May 8, 1926.

[2] Birkhaug, K. E.: Bacterial Allergy to Streptococcus Erysipelatis in Recurrent Erysipelas, J. A. M. A., 90: 1997–2001, June 23, 1928.

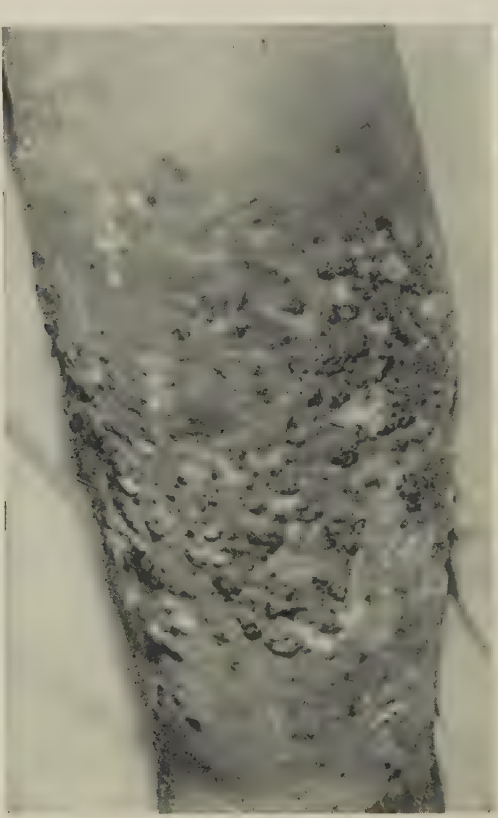

Fig. 363.—Papillomatous condition due to chronic recurrent attacks of erysipelas with persistent lymphedema of the leg.

From three days to a month after antitoxin injections, serum disease is likely to develop and is manifested by a moderate temperature, aches in the muscles, generalized enlargement of the lymphatic glands, and by various skin eruptions, which are usually widespread, itching, and urticarial. These are relieved by ephedrine sulphate, calcium lactate, catharsis, and a simple diet. The discomfort rarely lasts over a week.

x-Ray treatment has been widely reported as beneficial for erysipelas, but the author is still undecided regarding its value in severe acute cases. Because of the evanescent character of the affection, it has been difficult to estimate whether prompt involution is spontaneous or the result of treatment. Upon chronic recurrent erysipelas associated with lymphedema, fractional unfiltered exposures of roentgen rays are of proved benefit, possessing the power to decrease the swelling and to prevent recurrences. In my hands, fractional x-ray treatment has, in 2 cases of long standing, completely stopped attacks for over three years.

Although ultraviolet light has been accorded the property of aborting the disease in the early stages, the author has been unable to duplicate these results. Those interested in the literature may find references in the bibliography at the end of the chapter.

I treated a case of persistent lymphedema associated with lymphangiectasia of the skin of the shaft of the penis by dry heat, with resulting cure. The patient was a physician referred by Dr. E. L. Keyes. He had been circumcised in childhood and complained of a swelling of the skin near the frenum, which developed while he was in China three years before he consulted me. The swelling had been persistent and occasionally the skin was hot and erythematous. A biopsy showed only profuse lymphangiectasis. After daily treatment with twenty-minute exposures to dry heat there resulted an entire and permanent disappearance of the condition.

MISCELLANEOUS DISEASES

Cellulitis, mammary and ischiorectal abscess and vegetating papillomas due to pyogenic infection at times are benefited by well-managed radiotherapy. Of course, general surgical principles must govern the treatment, and demonstrable pus formation always demands drainage before the application of irradiation. Holzknecht has shown the potency of small doses of x-rays in the treatment of coccus infections, and Heidenhain has reported the results of radiotherapy in 855 cases of acute inflammations of various kinds. Fraenkel and Nissnjewitsch are convinced that the roentgen treatment of chronic purulent processes in soft tissues yields satisfactory results in a large majority of cases. The favorable action of ultraviolet therapy upon suppuration is more popularly but perhaps less deservedly known.

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CHAPTER XXII

DISEASES DUE TO FUNGI

DERMATOPHYTOSIS

This is an infectious disease of the skin caused by some of the hyphomycetes, which has a predilection for intertriginous areas but is capable of appearing on other parts of the body in a variety of manifestations and may produce a widespread eruption due to absorption of its toxins. Several clinical varieties may be differentiated. (1) The commonest is the vesicular form, which seems to be limited to the fingers and palms, and the toes and soles, rarely occurring on the dorsal surfaces. Usually the vesicles are superficial and tend to be of rather uniform size and discrete, with dark steel-blue centers. Occasionally they are large and coalesce or become pustular. The majority of eruptions have periodic exacerbations during which the patients are troubled by itching. (2) Intertriginous forms of this infection are common. Many persons suffer for years from fissuring and itching of the skin under and between the toes, accompanied by vesiculation and maceration of the epidermis, without realizing that these are the manifestations of a definite disease. It affects principally the webs of the fingers and of the toes, the groins, the intergluteal crease, the submammary folds, and the contact points of the penis and scrotum. Clinically maceration between the toes and between the fingers shows as clean white sodden tissue of various degrees of thickness, sometimes called epithelial débris, or soft corns. For some unknown reason the localization is especially common in the fourth interdigit of the foot. Fissures are liable to be present in either of the last

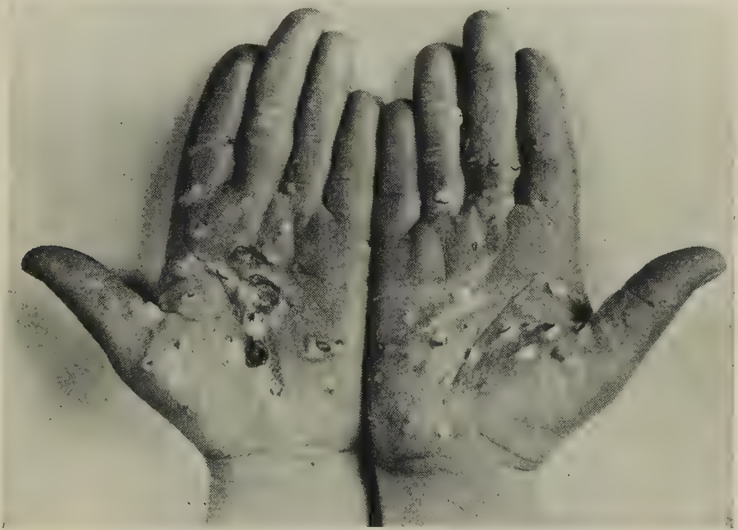

Fig. 364.—Dermatophytosis—vesicular type.

two types, being largely limited to the palms and soles, and to the webs between the toes. Although usually free of symptoms, the fissures may become exceedingly painful and through secondary infection give rise to erysipelas. (3) The circinate type, also called tinea circinata, is manifested by indefinite scaly patches accompanied by more or less local erythema; circinate, superficial scaly lesions with peripheral vesiculation; infiltrated raised patches with vesiculation or pustulation, and scaling; or deep nodular pustular lesions—tinea profunda. It is likewise a common variety, being found most frequently in men upon the upper and inner surfaces of the

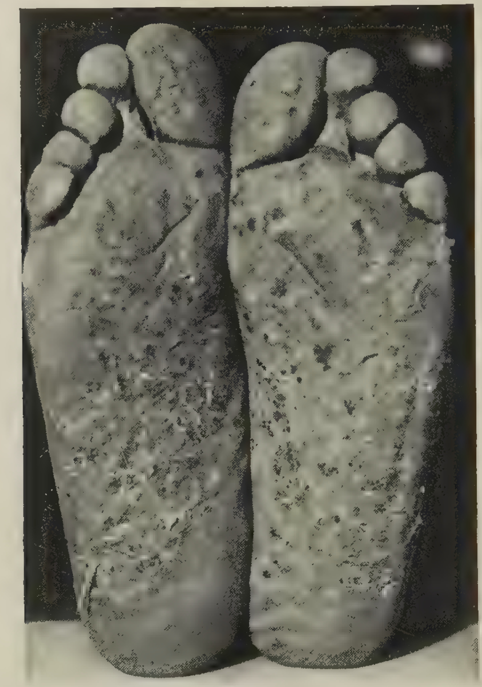

Fig. 365.—Dermatophytosis—vesicular and scaly lesions. (Courtesy of Dr. Frederick W. Birkman.)

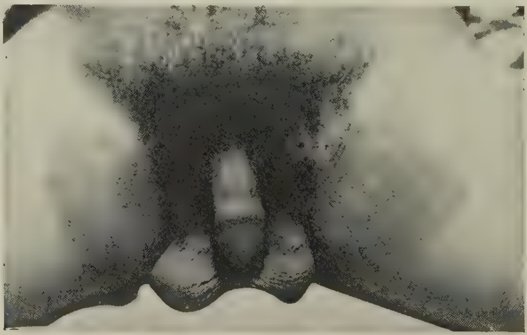

Fig. 366.—Dermatophytosis. Dhobie itch. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

thighs, in which location it is known as tinea cruris or popularly as jockey-strap itch, dhobie itch, or red-flap. The spreading border of the eruption is curved, well-defined, and vesicular. It may extend downward upon the

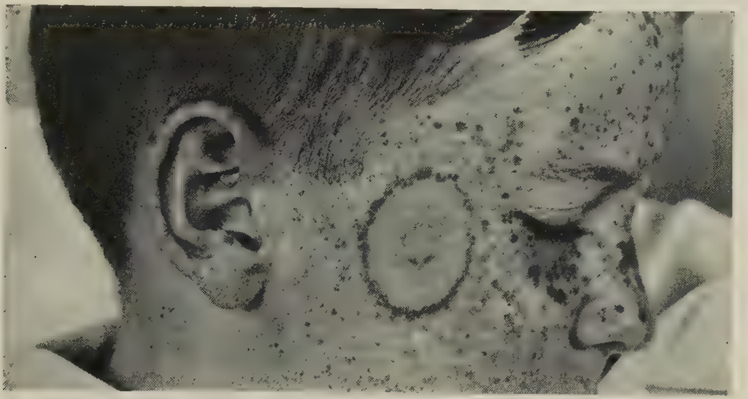

Fig. 367.—Tinea circinata.

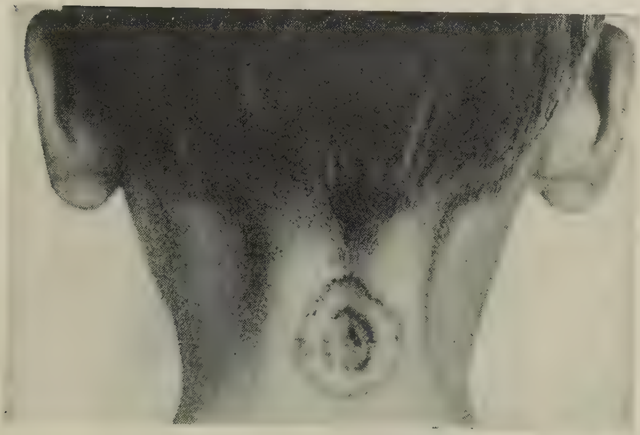

Fig. 368.—Tinea circinata.

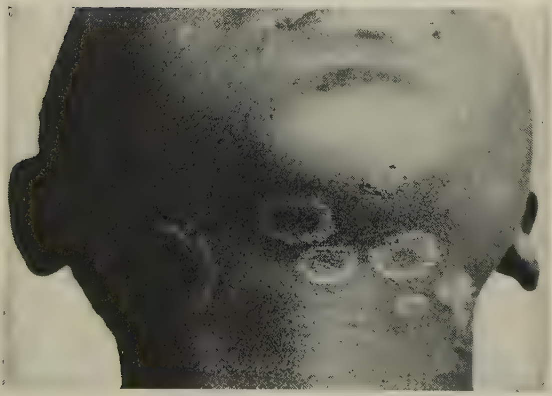

Fig. 369.—Tinea circinata.

thighs or backward about the anus. At times the genitals are involved. Frequent locations are also the face and the sides of the neck, the axillae, the surfaces beneath the breasts, and the umbilicus. (4) The scaling, often called eczematoid type, is most commonly observed on the sides of the fingers or of the toes, in their webs, and in discrete patches on the palms or soles; it may be generalized. (5) The verrucous type is either a diffuse hyperkeratosis of the palms or soles, or affects the same areas with multiple small keratoses.

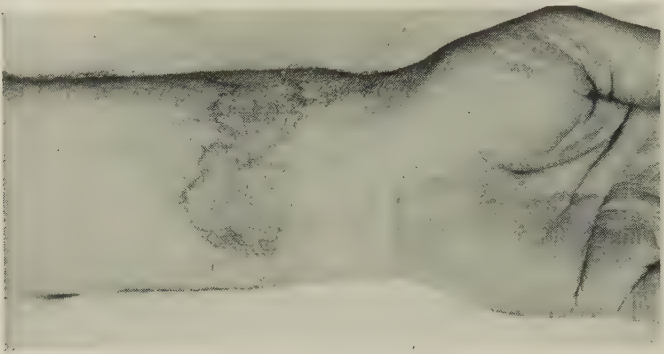

Fig. 370.—Tinea circinata.

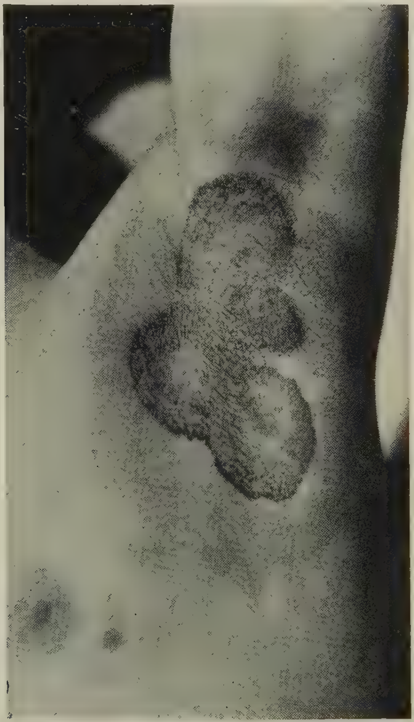

Fig. 371.—Circinate type of dermatophytosis, formerly known as eczema marginatum.

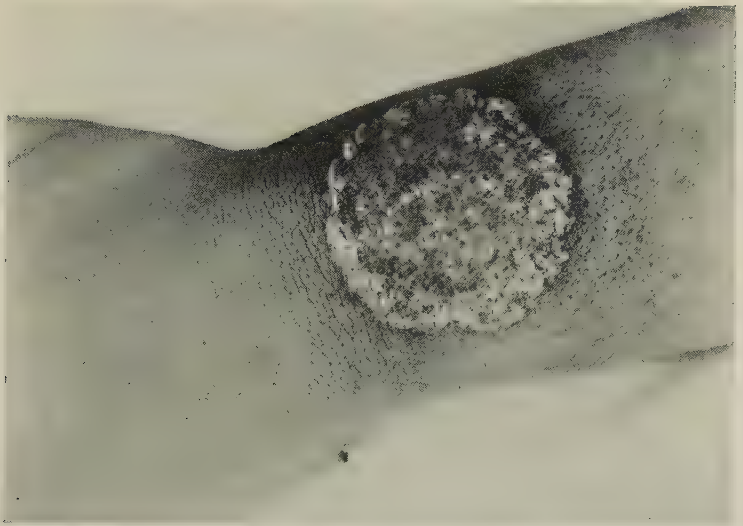

Fig. 372.—Tinea profunda of the dorsum of the wrist. (Courtesy of Dr. Charles W. McNitt.)

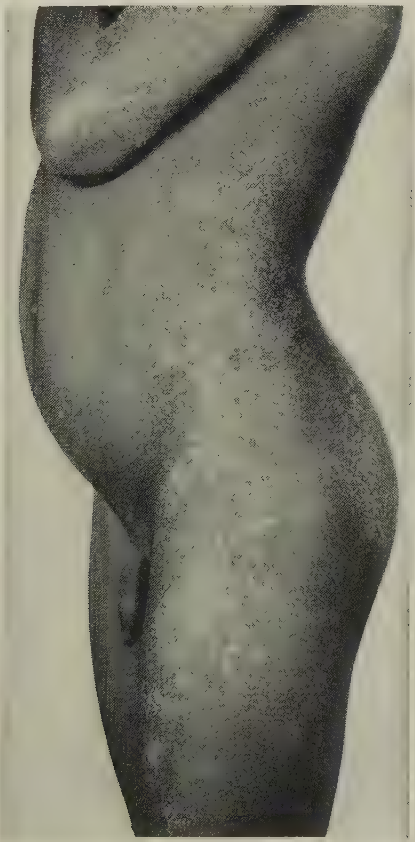

Fig. 373.—Disseminated dermatophytosis—scaling type.

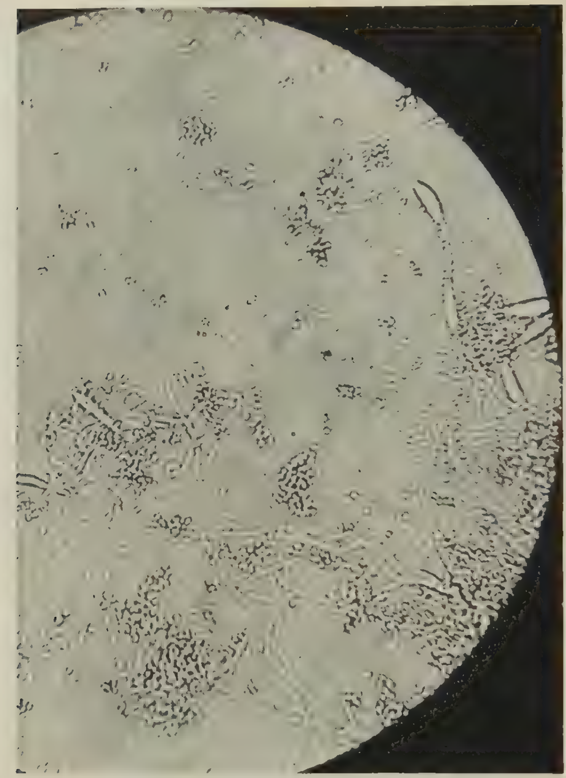

Fig. 374.—Ringworm of hand. Culture on slide showing characteristic spores—conidia, fuseaux and spirals. Trichophyton asteroides. (Courtesy of Miss Rhoda W. Benham.)

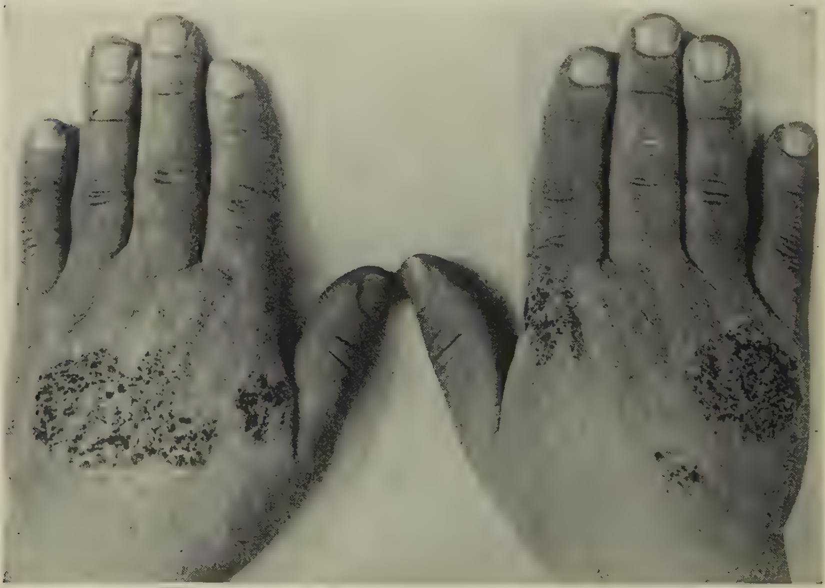

Fig. 375.—Eczematoid ringworm. In this case the fungus was demonstrated.

Lichenification due to rubbing may be superimposed upon any of these manifestations and at times may completely obscure the original condition. Dermatophytosis may also cause toxic follicular, macular, or papular, desquamative and lichenoid eruptions. Inguinal lymphadenitis may occur due to secondary infection. White obtained a positive fungus culture from an enlarged inguinal gland associated with an eruption on the feet.

Diagnosis may often be confirmed by the microscopical demonstration of the fungus. This may be attempted in two ways: (1) By direct examination of material from the eruption and (2) by the cultural method. At times it is necessary to resort to both methods.

Material for examination is removed and placed on a glass slide. When the lesion is a vesicle, it is clipped off close to the margin by small pointed scissors; when dry or scaly, the material is scraped off with a curet, an effort being made especially to obtain material from beneath the surface of chronic eruptions. A few drops of a 15 per cent solution of sodium hydroxide are added to the material on the glass slide. Gentle heat is applied until the scales are thoroughly macerated. A cover slip is placed over the specimen and pressed down firmly. It is then ready for a thorough microscopical study. The mycelia may be seen under low power, but better observation of both mycelia and spores is to be had by the high dry objective. The lines of juncture of normal epidermal cells are hyaloid and greenish, and must not be mistaken for fungous structures. The details may be established by Giemsa stain, as recommended by Weidman.

The other portion of the material is soaked in 95 per cent alcohol for thirty minutes in order to destroy the bacteria normally present and is then planted on Sabouraud's proof media. As soon as a growth appears it is transferred to fresh media in order to secure a pure culture.

Treatment.—As dermatophytosis is highly infectious to those who are susceptible, it is important that the patient be told of this fact and be warned against contact with likely sources. The fungus seems to be a frequent habitant of leather or woolen goods and damp dark places, such as swimming pools, bathrooms, Turkish baths, and shower rooms of clubs. Hyperidrosis and injury are predisposing factors. As the affection often starts on the feet, the patient should be advised not to go barefooted and to dry the toes thoroughly after bathing. Dryness of the parts is essential if reinfection is to be avoided.

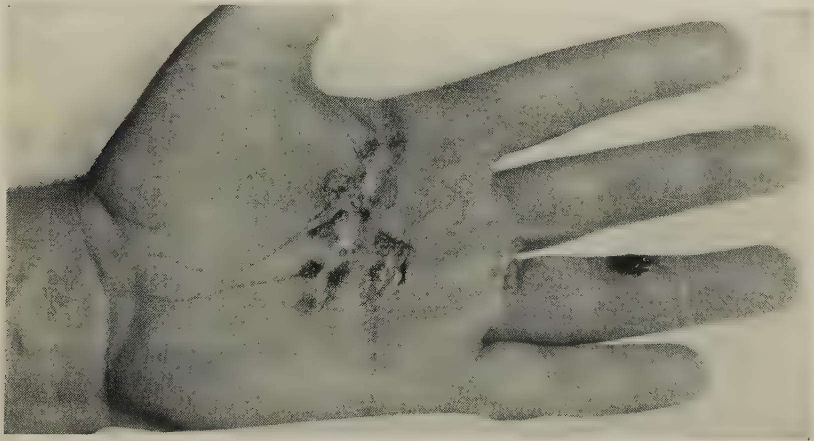

Fig. 376.—Dermatophytosis—a common appearance and location.

Of the many local remedies that have been used not one can be depended upon to effect a cure. Salicylic acid, sulphur, thymol, and iodine are the most beneficial drugs, but their action is often insufficient. Each case is an individual problem, and the response to treatment is by no means uniform. Roentgen therapy is as valuable as, if not more so than, local medicines. For the sake of clarity the treatment of each type will be discussed separately.

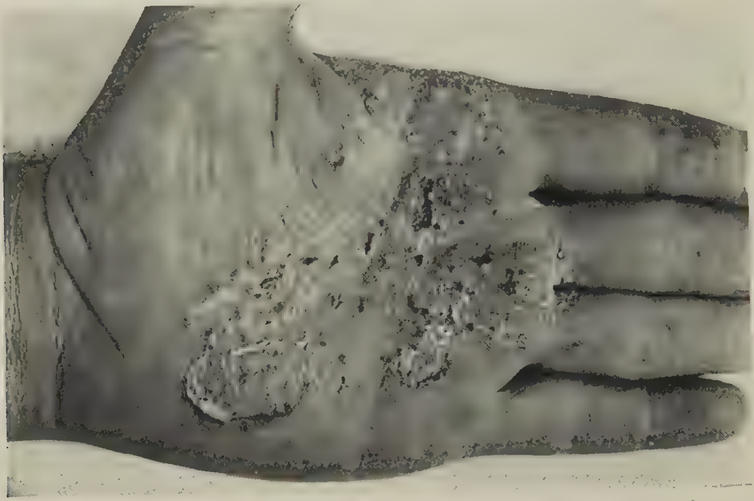

Fig. 377.—Dermatophytosis. Note well-defined edges and a tendency to form circinate lesions.

1. *Vesicular Type.*—*x*-Rays are the most important remedy. Although at times patients with this affection are not cured by them, there is nearly always a favorable response, even to a fractional dose. Roentgen-ray treatment is indicated at any stage and may also be applied upon the very acute eruptions with benefit. The dosage should always be fractional, erythema being avoided. Unfiltered radiation given weekly in doses of $\frac{1}{4}$ E. D. to the flexor and extensor surfaces of the affected hands and feet for a period of

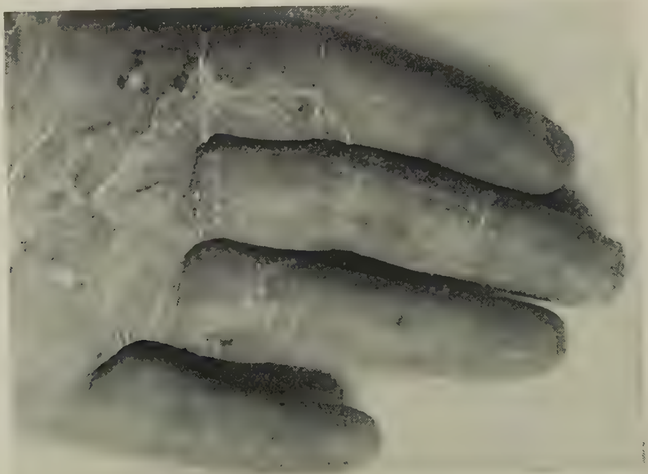

Fig. 378.—Dermatophytosis. Note the circumscribed, well-defined, desquamating patch, and the neighboring vesicles, and that the little finger is not involved.

three or four weeks usually affords complete relief. Where the lesions are situated principally on the sides of the fingers, the hand should be so placed during exposure that the direct beam falls at right angles to the plane of the sides of the fingers instead of directly upon the palm. Very often in applying the *x*-rays to the soles it is well to treat the ball separately from the heel. Simultaneously with radiation, soothing lotions containing calamine and zinc, aluminum acetate, or tincture of benzoin assist in relieving the discomfort. These may contain small amounts of phenol, thymol, or menthol. The itching is frequently annoying and can be best relieved by opening many of the larger and more tense vesicles, after which it is advisable to soak the parts for ten minutes in diluted hydrogen peroxide or potassium permanganate solution, and then paint them with 2 per cent mercurochrome or 10 per cent silver nitrate solution. Lassar's paste or Whitfield's ointment is commonly efficacious. The strength of the latter is varied

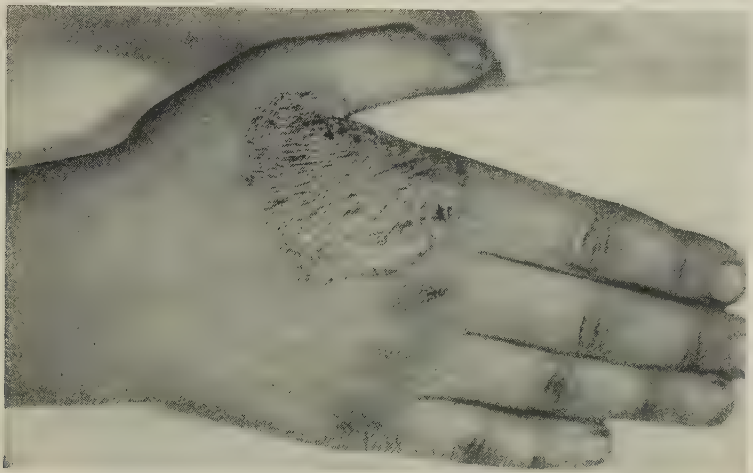

Fig. 379.—Dermatophytosis, somewhat lichenified.

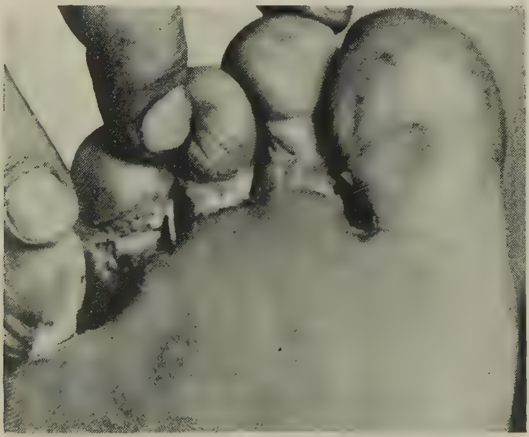

Fig. 380.—Ringworm of the toes. Note white macerated epidermis under and between toes, and the erosion beneath the fourth toe.

according to the tolerance of the patient, no more than half-strength being used during x-ray treatment.

℞.	Acid. salicylic	ʒss
	Acid. benzoic	ʒj
	Adipis lanae hyd.	ʒj
	Petrolati q.s. ad.	℥j

M. and S. Whitfield's ointment.

One to two per cent chrysarobin ointment may be substituted in recalcitrant cases. Purulent manifestations are usually due to secondary infections with staphylococcus, but there is some reason to believe that pus may be occasionally caused directly by the fungi. Drainage of the vesicles, the application of a wet dressing, rest of the part and x-ray treatment give quick relief in pustular cases.

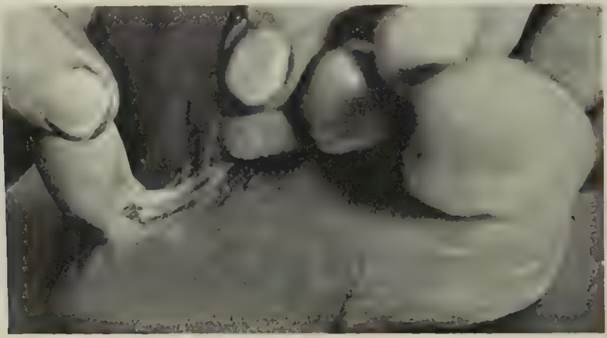

Fig. 381.—Ringworm of the fourth interdigit, which is the commonest location. Note white sodden epidermis and the fissure.

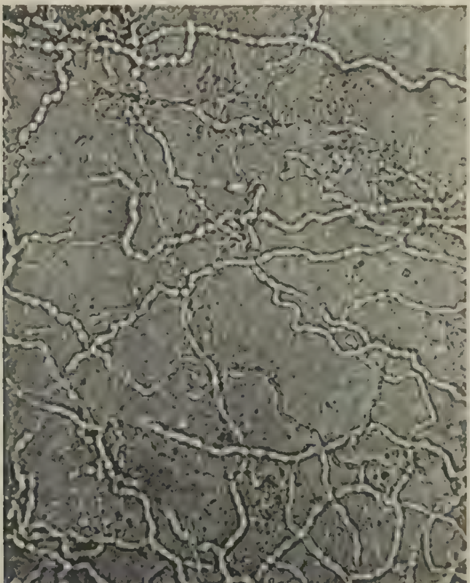

Fig. 382.—Ringworm of foot. Slide showing mycelium and spores in skin. (Courtesy of Miss Rhoda W. Benham.)

2. *Intertriginous Type.*—The average eruptions respond well to local remedies without roentgen irradiation, which is nevertheless beneficial when used. Of the innumerable drugs used in this affection salicylic acid ointment, tincture of iodine, and thick calamine lotion are the most effective. The routine treatment to be borne in mind should be: wet dressings and soothing applications for the very acutely inflamed or irritated eruptions, and for others, gradually increasing strengths of salicylic acid ointments. An excellent procedure throughout the entire course of treatment is to have the hands and feet soaked in a solution of potassium permanganate (1 : 5000) for ten minutes daily, or

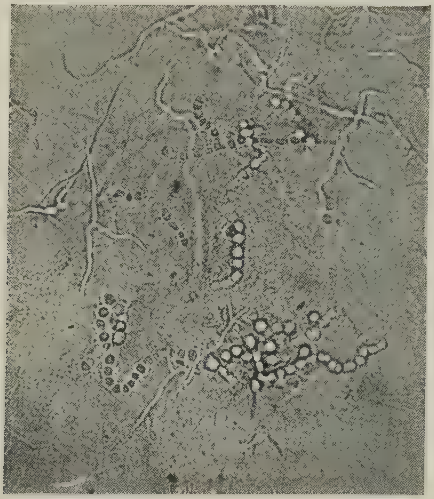

Fig. 383.—Ringworm of foot. Mycelium and spores in skin. (Courtesy of Miss Rhoda W. Benham.)

℞.	Cupri sulphatis	5
	Zinci sulphatis	15
	Camphorae	4
	Sodii sulphatis	q.s. ad. 200

M. and pulverize. Sig. Two tablespoonfuls to a tub of water.

A drying and medicated dusting powder should be used on the feet after the bath, and in the socks. When fissures are present, they should be cauterized with silver nitrate. The following prescriptions are suggested:

℞.	Thymol iodide,	
	Acid. boric pulv	āā ℥j
	Talc	q.s. ad. ℥iv

Mix and dispense in shaker bottle.
Label: Medicated powder.

℞.	Acid. salicylic pulv	℥j
	Talc	q.s. ad. ℥iv

Mix and dispense in shaker bottle.
Label: Foot powder.

℞.	Acid. salicylic	ʒss
	Sulphur. praec	ʒj
	Adipis lanae hyd	℥j

M. and S. Between toes morning and night.

℞. Acid. salicylic	gr. xv–ʒj
Ung. plumbi oleatis	℥j

M. and S. Between toes.

℞. Ung. plumbi oleatis,	
Emplast. saponis (N. F.)	āā ℥j

M. and S. Apply thickly to soften horny thickening of epidermis.

℞. Mercurochrome–220 soluble	ʒss
Alcohol, 95 per cent	℥ij

M. and S. Paint between toes morning and night.

℞. Zinci chloridi	ʒj
Alcohol, 50 per cent	℥ij

M. and S. Paint between toes morning and night.

℞. Calamin. praec.,	
Zinci oxidi	āā ℥j
Phenolis	gr. xxx
Glycerin	℥ss
Mentholis	gr. x
Liq. alumini acetatis (Burowii)	q.s. ad. ℥iv

M. and S. Between toes on pledget of cotton morning and night.

Recalcitrant eruptions of the intertriginous type on the toes yield readily to the beta rays of radium. In my hands the best method of application has been the bulb or a bare tube on the end of a handle. The affected area is covered with vaselin and the glass container is placed in contact with the surface and moved to and fro over it until a dosage of 200 to 300 millicurie minutes per square centimeter has been given.

3. *Circinate Type.*—The treatment of this type is largely medicinal, a quarter- to half-strength of Whitfield's ointment, tincture of iodine, or sulphur ointment being used because of the sensitiveness of the skin of the flexures. When the lesions are severely irritated from friction or secondary infection or are deeply nodular, pustular or accompanied by furunculosis, roentgen therapy is of value. Usually one exposure of ½ to ¾ E. D., unfiltered, is sufficient, but when there are deep abscesses an equivalent dose, filtered, is preferable. Sunlight or ultraviolet light is slowly beneficial when the involvement is extensive and of long duration.

4. *Scaling Type.*—This usually yields to local parasitic remedies, of which tincture of iodine, sulphur, and salicylic acid ointment, 4 per cent of each, and 5 per cent of ammoniated mercury ointment are the most popular. When the inflammation is pronounced, it may be best allayed by calamine lotion prior to the application of antiparasitics. Fractional doses of unfiltered *x*-rays are extremely effective in most cases, but occasionally one meets with eruptions that, after many kinds of treatment, have reached a chronic resistant state, which does not seem to be favorably influenced by any local measure except dryness and sunshine.

5. *Verrucous Type.*—This responds to keratolytic ointments and plasters containing salicylic acid or chrysarobin, or to *x*-ray treatment, which may be applied in either of two ways: (*a*) The thickened area is peeled by strong keratolytics, and after the irritation of the skin has subsided, these are stopped, and soothing remedies are used, then *x*-rays are applied in fractional doses for a few weeks. (*b*) The keratotic patch is shaved down thoroughly with a razor blade, and it is then treated by radiation only, no keratolytics being used. The radiation is preferably filtered and given in doses of

$\frac{3}{4}$ to 1 E. D. at intervals of three weeks. On small areas larger amounts are employed at longer intervals ($1\frac{1}{2}$ to 2 E. D.).

Where there are multiple small keratotic lesions, unfiltered radium gives the most rapid and best results. It may be applied in a glass bulb or tube, contact, for 200 to 500 millicurie minutes to each lesion, or with a half-strength flat salt applicator, unscreened, contact, shielded as indicated, for two to four hours.

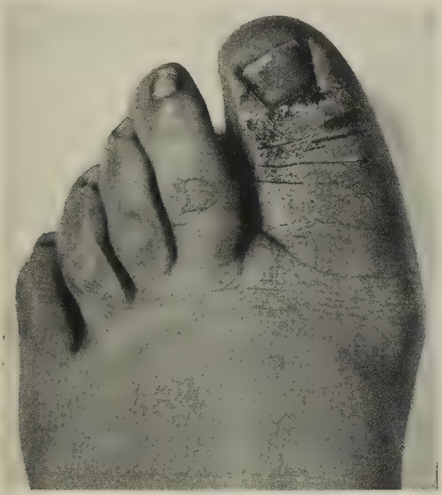

Fig. 384.—Eczematoid ringworm. This type is often secondary to onychomycosis. Also called scaling type.

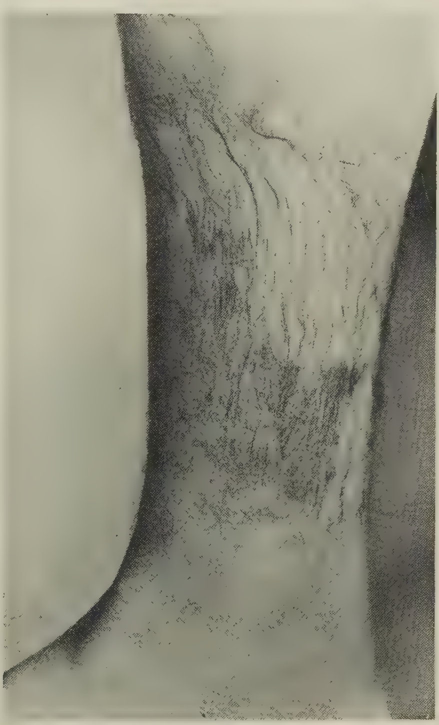

Fig. 385.—Chronic recurrent erysipelas of the lower leg. This is usually secondary to ringworm of the toes.

The treatment of the lichenification which may accompany or supersede dermatophytosis follows that described for neurodermatitis, except that the patient should be thoroughly searched for foci between the toes and elsewhere, and these together with the lichenified areas should be treated by antipruritic ointments.

TINEA CAPITIS

Synonyms.—Ringworm of the scalp, herpes tonsurans, tinea trichophytina capitis, tinea tonsurans.

Ringworm of the scalp is an infectious disease occurring principally in school children and occasionally in infants and adults. In this locality it is caused generally by the Microsporon, occasionally by the endothrix, and rarely by the ectothrix. The species audouini and lanosum of the Microsporon are the most common types found in this country. The clinical picture shows one or more circular patches of erythema, crusts, or follicular pustules. The hairs in this affected area become loose and break off just above the skin surface, leaving stumps about 3 mm. long. Sometimes the lesions caused by the endothrix resemble those of the microspora, but the patches are generally smaller, the alopecia less complete, and the hairs are broken off at the surface of the scalp, so the stumps are not as regularly seen. Less commonly the lesions may be extremely suppurative and boggy, forming isolated, fluctuating, indolent abscesses, or aggregated in raised inflammatory swellings formed of small abscesses. The latter type of lesion is called kerion, and is usually caused by the ectothrix, occasionally by the Microsporon, especially M. lanosum. Rarer varieties resemble alopecia areata or are characterized by baldness, severe dandruff, or small black plugs resembling comedones.

Diagnosis.—*Ultraviolet* wavelengths of about 3650 Å. u., which are obtained by passing the beam through a Wood's filter composed of glass containing nickel oxide, have a significance in the diagnosis of ringworm of the scalp. For good effects it is important that the source of radiation should give a limited amount of infra-red rays, and the filter should prevent the passage of wavelengths within the visible spectrum. The Correx filter of red- or blue-purple glass may be substituted for the Wood's filter.

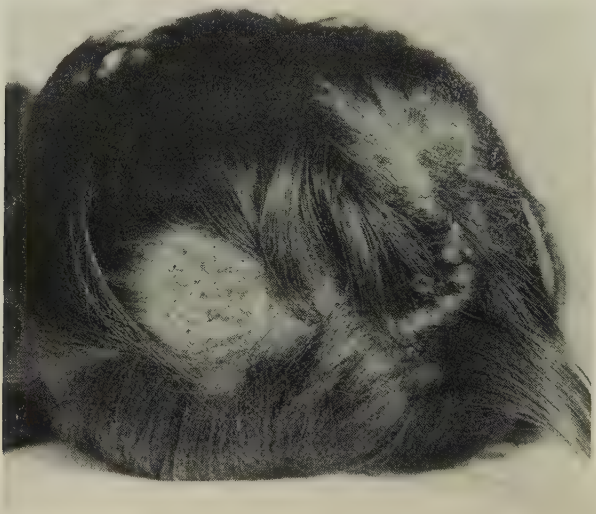

Fig. 386.—Tinea capitis in a child.

In a dark room under this light the skin fluoresces faintly, and is somewhat blue. Vigne was the first to demonstrate the detection of ringworm infection by this method. The fluorescence shows as brilliant beads on the hairs, contrasting strongly with the dark field; bare scaly areas show as turquoise blue.[1] As lanolin, petrolatum, blood, and other organic materials upon the skin also fluoresce, this phenomenon must be distinguished from the fluorescence of the fungi in the hairs. A water-cooled lamp is easier to use as a source of radiation than the air-cooled lamp, but the latter can be employed by inserting the Wood's filter over the small opening in the hood.

By examination under Wood's light it is possible to determine the extent and location of ringworm quickly and accurately where the infection is suspected and where clinical signs have become apparent. Other conditions producing clinical appearances similar to ringworm may thus be promptly excluded, treatment can be instituted, and cure attempted by topical application while the infection is still limited to a small area. After treatment has been applied by x-rays or epilation by thallium acetate or by local remedies, examination under the Wood's light may reveal hairs which have escaped, and may thus prevent relapses which otherwise occasionally occur, and which are not disclosed until they have produced clinical symptoms. The same technic is of value in the diagnosis of tinea barbae. The results are usually confirmed by microscopical examination of the fluorescent hairs.

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[1] Cleveland, D. E. H.: Wood Light in Dermatologic Diagnosis, Arch. Dermat. and Syph., 18: 370, Sept., 1928.

For *microscopical* demonstration of the fungus, two or three loose hairs are removed by forceps from the suspected area. It is important to cnoose loose hairs, and it is preferable to take them from a place which has not been treated by antiseptics. If strong antiseptics have been applied, it may be necessary to stop them and to repeat the examination after an interval of two weeks. The hairs are placed upon a slide and covered with a few drops of a 15 per cent solution of sodium hydroxide. The slide is warmed over a Bunsen flame until the hairs are macerated. A cover slip is then applied over the specimen, and it is examined with the high dry objective. It is often possible to distinguish the Microsporon from the Trichophyton by microscopical examination, but identification of finer characteristics can be made only by cultures upon special media.

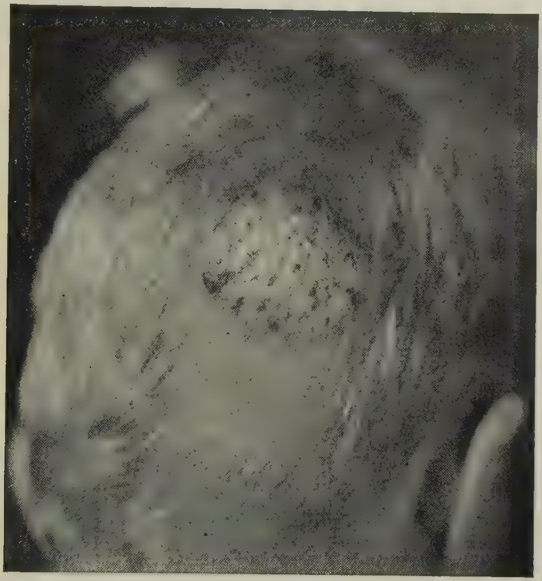
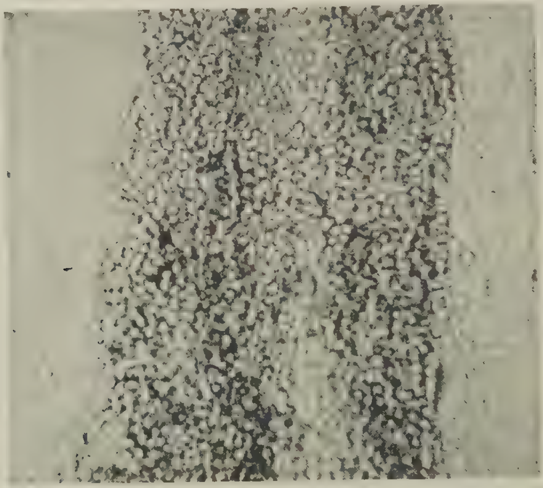


Fig. 387.—Tinea capitis, kerion type. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Ringworm of the scalp must at times be differentiated *clinically* from favus, alopecia areata, and seborrheic dermatitis. Only very rarely has ringworm of the scalp been observed in patients over fifteen years of age and although favus can occur in adult life, it is more frequent in childhood. Alopecia areata and seborrheic dermatitis can occur at any age. The distinctive clinical features of ringworm of the scalp are broken-off stumps of hairs usually in rounded erythematous patches in which there are crusts or pustules and a sparsity of hair. The broken-off hairs are loose and when examined are found to be surrounded by or to contain the ringworm fungus.

In favus, the principal features are sulphur yellow, dry, cup-shaped scutula, or crusts associated with atrophic scars and permanent alopecia of varying extent. The hairs in both diseases lose their luster, but in favus do not break off near the scalp as regularly as in ringworm. Favus in this country generally is seen in immigrants from Poland and Russia. The diagnosis is established by the demonstration of the Achorion schönleinii. In alopecia areata the affected patches are completely bald and the skin is smooth and shiny without any signs of inflammation and without scaling. There are no stumps of broken-off hairs, and no fungi are demonstrable. In seborrheic dermatitis the involved areas are covered by fine, dry, or greasy scales. When



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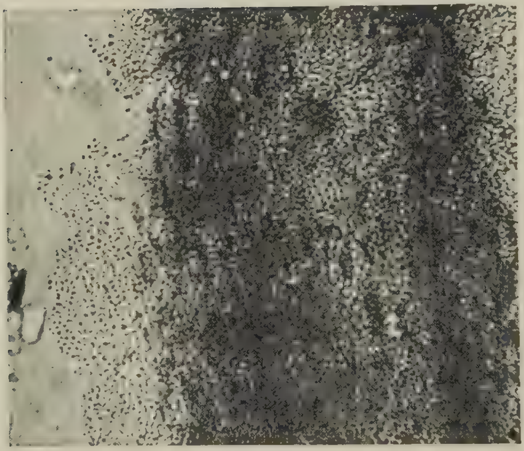

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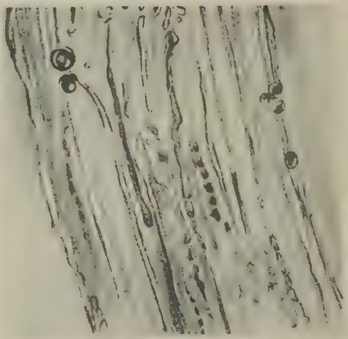


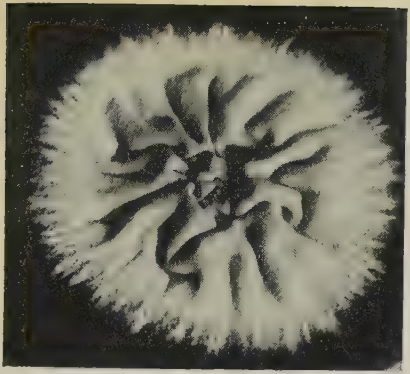
Fig. 390.

Figs. 388–390.—Microphotographs and drawing of hairs in tinea capitis. (Courtesy of Miss Rhoda W. Benham.)

Fig. 388.—Large spore endothrix type.

Fig. 389.—Microsporon lanosum. Note sheath around hair, which was from a case of ringworm of the scalp in an adult, aged thirty-five.

Fig. 390.—Favus, hair. Drawing by Jessie Bodley.



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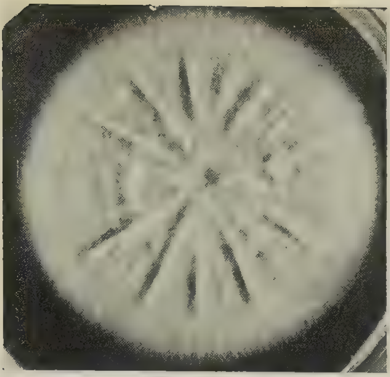

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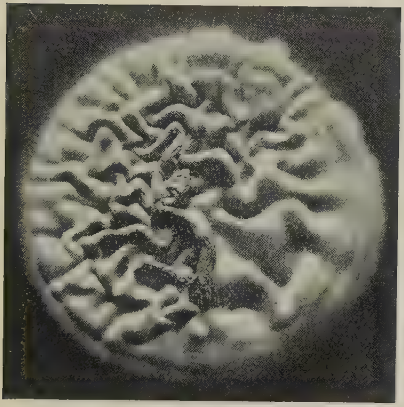

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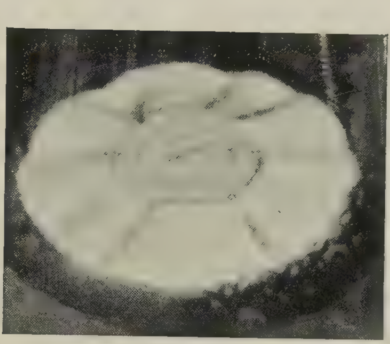

Fig. 394.

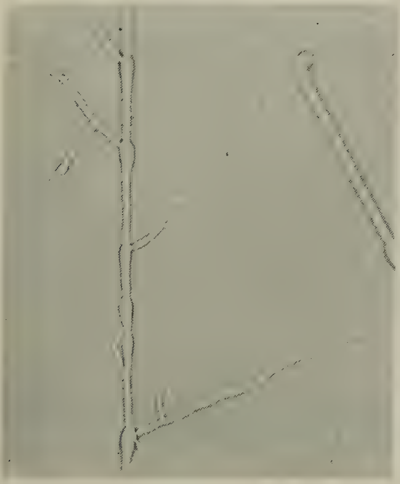

Fig. 395.

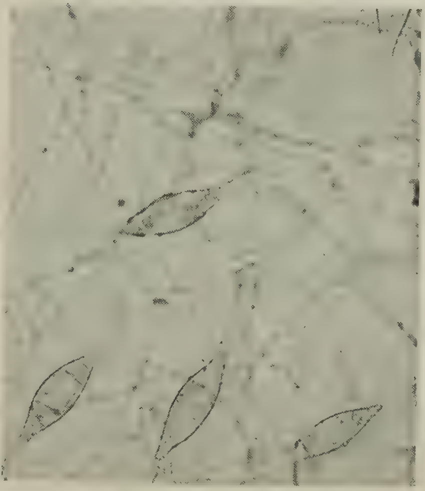

Fig. 396.

Figs. 391–396.—Cultures from tinea capitis. (Courtesy of Miss Rhoda W. Benham.)

Fig. 391.—Endothrix type, Trichophyton sulphureum, on maltose agar showing characteristic folds. Color is a sulphur yellow.

Fig. 392.—Microsporon lanosum, on maltose agar, two weeks.

Fig. 393.—Trichophyton niveum, on honey agar, five weeks.

Fig. 394.—Large spore endothrix, Trichophyton acuminatum.

Fig. 395.—Microsporon audouini, drop culture showing "racquet" mycelium.

Fig. 396.—Microsporon lanosum, drop culture showing characteristic spores, the fuseaux.

the scales are dry they are branlike and not adherent to the scalp but flake off upon the hair and clothing, whereas when they are greasy, they are adherent to the involved area, which they cover with a thick crust. There is usually no pustulation and there are no broken-off hairs.

Treatment.—Temporary improvement frequently follows strong *antiparasitic remedies*, but such relief is seldom permanent, and cures from them are therefore infrequent. The treatment is tedious and difficult. By persistent, intelligent cooperation cures may be obtained. In some parts of the country ointments seem to give better results than in other localities. Possibly this difference is explained by variations in the strains of the fungi. Inasmuch as the microsporon ringworm may spontaneously disappear at puberty, treatment by medicinal applications is occasionally preferable in patients who are close to fifteen years of age. The daily application of ointment is preceded by vigorous shampoo with soap and water and the removal of all crusts and brittle hairs, such detritus being burned. Of the remedies employed, 20 per cent sulphur ointment, 10 per cent iodine in goose grease, 10 per cent chrysarobin ointment or an ointment containing 25 per cent oleate of mercury, 5 per cent oil of cade and 5 per cent salicylic acid have been the most successful. Kingery reported a method of treatment with which he was very successful in a short series of cases. While the method has not been thoroughly proved, the results obtained seem to justify its further trial.

The measures carried out were as follows:

1. Clipping of the hair to the extent of 1½ inches (3.8 cm.) around the border of the lesions when only one or two lesions were present.
2. Clipping of the hair of the entire scalp when the disease was generalized.
3. Constant wearing and frequent changing of a washable cap.
4. Biweekly soapsuds shampoo.
5. The application of a solution of gutta-percha B. P. C., containing ½ of 1 per cent thymol and 1 per cent of cinnamon, three times daily. In cases in which this resulted in irritation, the frequency of the applications was decreased.

In 1897 Freund of Vienna was the first to suggest the use of *x*-**rays** in the treatment of ringworm of the scalp. In 1904 Sabouraud and Noiré of France employed a special radiometer and produced depilation with a single dose. Kienböck and, later, Adamson suggested methods of dividing areas of the scalp for treatment. Irradiation of the scalp for fungous diseases is founded upon the peculiar selective action of roentgen rays and radium for the hair follicles, which permits temporary epilation without damage.

Where the disease involves only one or two small areas the physician is often asked by the parents if epilation of these areas will suffice. Regardless of the care exercised to prevent the spreading of the disease from small areas, it has invariably been my experience that partial epilations are unsuccessful. It is necessary to epilate the entire scalp, although the diseased areas may be small and few.

Irritating ointments should not be applied to the scalp previous to radiotherapy. If these have been applied, two weeks should intervene before irradiation. If the scalp has become irritated by the use of antiparasitics, the inflammation must subside entirely before roentgen rays are employed. If these precautions are not taken, a radiodermatitis or permanent alopecia may follow.

Directly preceding radiation the entire hair is cropped about $\frac{1}{4}$ inch above the skin surface; shaving is unnecessary. The scalp should then be washed with green soap until the crusts are removed. It may be marked for epilation with a skin pencil and either a tape measure or a tinea marker, to indicate the *Kienböck-Adamson points and lines.*

In the former method, after the hair has been clipped, a mark is made with ink or a skin pencil on the vertex at the crossing of a line drawn from the center of the nucha to the center of the forehead in the sagittal plane, and another drawn over the vertex in the frontal plane from points slightly in front of the ears equidistant between the anterior and posterior ends of the first line. The crossing of these lines on the vertex forms point A. A circumferential line is then drawn about the base of the calvarium at a distance of 5 inches from the point on the vertex. This line usually intercepts the sagittal and median lines at points about 1 inch above the anterior and posterior hair margins and above each pinna, forming respectively points B, C, D, and E.

To recapitulate, the Kienböck-Adamson points are:

A = $\frac{1}{2}$ to 1 inch anterior to the center of the flat area which forms the upper part of the occiput.

B = 1 to 1$\frac{1}{2}$ inches behind the frontal margin of the hairy scalp in the midline.

C = 1 to 2 inches above the border of the scalp at the lower part of the occiput in the midline.

D and E = 1 to 1$\frac{1}{2}$ inches above and in front of the ears.

It requires from ten to thirty minutes to mark out the scalp by this method. The time consumed will depend upon the skill of the operator, the shape and size of the head and, above all, the behavior of the patient. It is exasperating to a busy physician to waste a half hour with a refractory child, preparing the head for treatment. Furthermore, this fussing often makes an apprehensive child so nervous that the treatment can only be given with considerable difficulty.

The *tinea marker*[1] is a time-saving device made of celluloid or of an ordinary flexible steel tape measure. The use of this marker requires no more than a minute or a minute and a half, and the child is rather amused at and interested in the new kind of hat, instead of being apprehensive. The base is a circular band to which are attached two cross pieces. The ends of the cross pieces are riveted to the circular band at places representing the anterior, posterior, and lateral Kienböck-Adamson points. The intersection of the two cross pieces is also riveted. This represents the central or vertex Kienböck-Adamson point. A glance at the photograph of the marker will show that the cross pieces are set at right angles to each other and at right angles to the circular band. When a home-made marker is being constructed, it is advisable to join the cross pieces to the base in such a manner that measurement begins at the lower border of the latter.

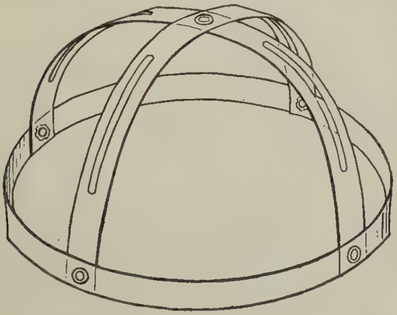

Fig. 397.—Tinea marker.

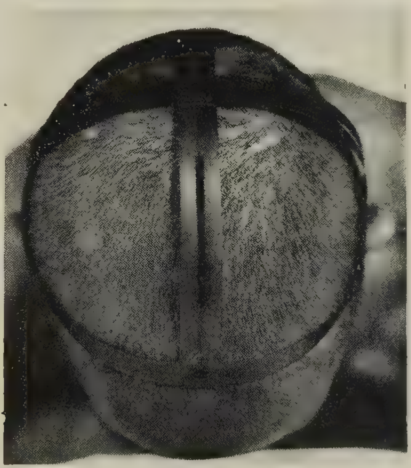

Fig. 398.—Hair clipped for treatment. Tinea marker in place.

Because of age, sex, race, *et cetera*, heads differ somewhat in both size and shape, which does not materially affect the results obtained by this technic. It, however, makes it difficult to construct an instrument or marker that will instantly and accurately indicate the Kienböck-Adamson points and lines on any head. The circumference of the head of the average patient with tinea tonsurans is 20 inches, providing it is obtained from points in the sagittal plane 1½ inches inside of the anterior and posterior hair lines and from points 1 inch above each pinna. Measured in this manner, the heads of some children show a circumference of 21 inches, while in others it is only 19 inches. Adult heads, free of hair, measured in this manner usually show a circumference of 22 inches. When preparing a head for roentgen-ray treatment it is not necessary to note the location of the circumferential line in relation to anatomical landmarks. It makes no difference whether the Kienböck-Adamson points are on the anterior and posterior hair lines or a considerable distance inside of the hair lines. The lateral points may be an inch or more above the ear, or very close to it. The chief requisites are to have the points 5 inches apart (see below) and so placed that lines drawn between these points are at right angles. As a rule it is possible to have the marks 5 inches apart, but this is not always so. In small heads the marks will be 4¾ inches apart, while in large heads the distance will be 5¼ inches or even 5½ inches. The variation in distance between the Kienböck-Adamson points does make a difference in the dose received at any spot between the points, but this difference can be corrected by changing the skin-target distance. This point will be discussed later.

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[1] MacKee, G. M., and Andrews, G. C.: Time-saving Devices for Roentgen-ray Treatment of Ringworm and Favus of the Scalp, Am. J. Roentgenol., 9: 746–751, Nov., 1922.

The marker is made in three sizes for children, the largest size often being suitable for adults. The size that is by far the most used has a circumference of 20 inches, and the Kienböck-Adamson points are 5 inches apart. For smaller heads the circumference is 19 inches and for the larger ones there is a circumference of 21 inches.

With the instrument in position on the scalp, the five points are marked with indelible pencil. The marker is then removed, and each of the five points on the scalp is given an epilating dose of unfiltered *x*-rays.[1]

It is convenient to treat the vertex point A first. For this *exposure* the child lies prone, with the chin so supported that the vertex point is uppermost. The eyes are shielded with lead spectacles and the shoulders with lead-rubber. Point C at the base of the occiput is next treated. To obtain a proper position for the child, a pillow is inserted under the chest and the head is strongly flexed forward so that it hangs down over the edge of the pillow giving good exposure to the point at the base of the occiput. Shielding is the same as in the previous position. For the other parts the child lies on his back. The lateral points D and E, over the ears, are conveniently treated next. The operator begins with the right side, the right ear being held forward by adhesive strapping so that it is withdrawn from the field and lies flat on the cheek. The child's head is turned to the left, the face is shielded, and focus is made. After exposure the head is turned to the right and the left ear is held forward with adhesive. The shielding is similar to that of the preceding exposure. The last point, B, to be treated is most difficult because a child objects to his face being covered with a heavy sheet of metal. The median frontal point is prominently exposed by raising the head on two or three pillows, so that the chin is resting on the chest, while the child is lying on his back. The eyes are covered with lead spectacles and the face, with lead-rubber sheeting.

Proper shields for the face and shoulders may be used by cutting 1 square yard of lead-rubber 3 mm. thick into three pieces. The exact shape of each is depicted in the accompanying illustrations. One shield is for the face, one for the sides of the neck and shoulder, and the third is for the back of the neck, the shoulders, and the back. These shields are easily sterilized and are always ready for use. They afford ample protection and last several years.

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[1] The output from different standard Coolidge tubes is not always the same because of variations in the thickness of the glass walls. Filtration seems to minimize these differences, which naturally encourages its use. It is also possible that the difference between the amounts necessary to effect a temporary or permanent defluvium is a little greater with filtered than with unfiltered radiation. However, with the usual factors employed for filtered therapy, the exposure time would be so long that the average child would not lie quiet and the focus would thus be changed. Whereas light filtration (0.5 mm. aluminum) is used by many authors, our ionization measurements have not shown any material improvement in the differences of output from various Coolidge tubes by its use. The clinical results have been in favor of unfiltered therapy because it gives epilation without the severe systemic reactions which often follow filtered radiation, because it is rapid, convenient, and has given complete satisfaction in thousands of cases.

Causes of *anxiety* or fear on the part of the child are often of trivial origin. Any mention of pain or fear gives a sense of terror, and therefore such expressions should be carefully avoided. If pillows are placed against the child's nose, breathing is often obstructed, which causes great restlessness and anxiety. The jumping of the sparks across the gap is frequently terrifying and unnecessary. Static electricity from sheet-lead used in shielding may make treatment impossible, for which reason it is best to use lead-rubber.

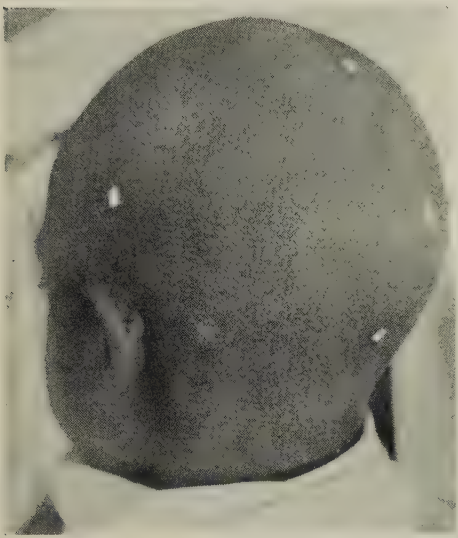
Fig. 399.—Focus points as indicated by the marker.

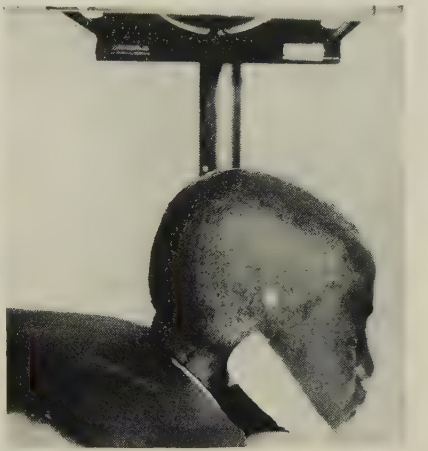
Fig. 400.—Treatment of vertex point, A.

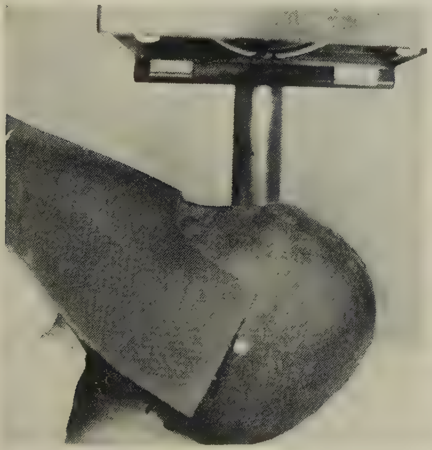
Fig. 401.—Treatment of occiput point, C.

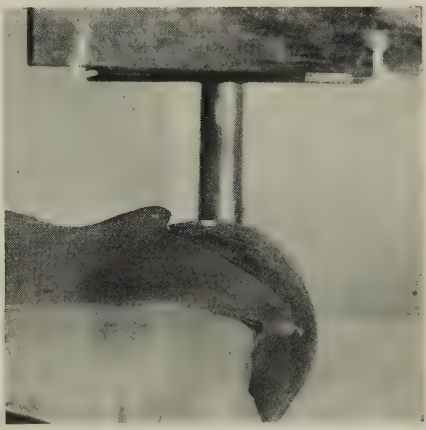
Fig. 402.—Treatment of right lateral point, D. Face is rotated toward the observer and is covered with lead-rubber sheeting.

On *angular heads* special care should be exercised to arrange the focusing and overlapping so that equal distribution is given to the dose. It is very important that the direct beam of the radiation be at right angles to the sagittal or frontal planes and that the direct rays of the vertex exposure be in line with an imaginary perpendicular erected through the vertex point from the center of the area included within the circumferential line. These rules about focusing are illustrated by Figures 399–404.

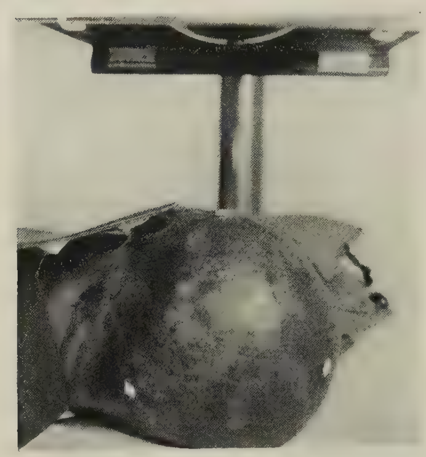

Fig. 403.—Treatment of left lateral point, E. Face is rotated away from the observer and is covered with sheet-lead.

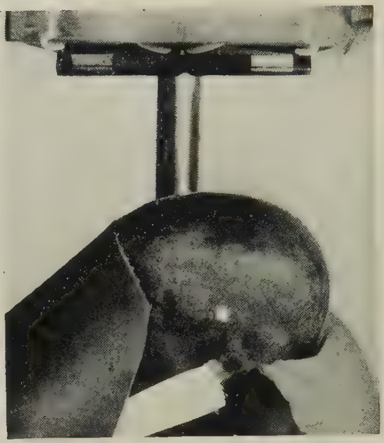

Fig. 404.—Treatment of frontal point, B. Note that ears have been pulled forward by adhesive strips, that the occiput is supported upon a sand bag, and that the face is covered by a sheet of lead-rubber.

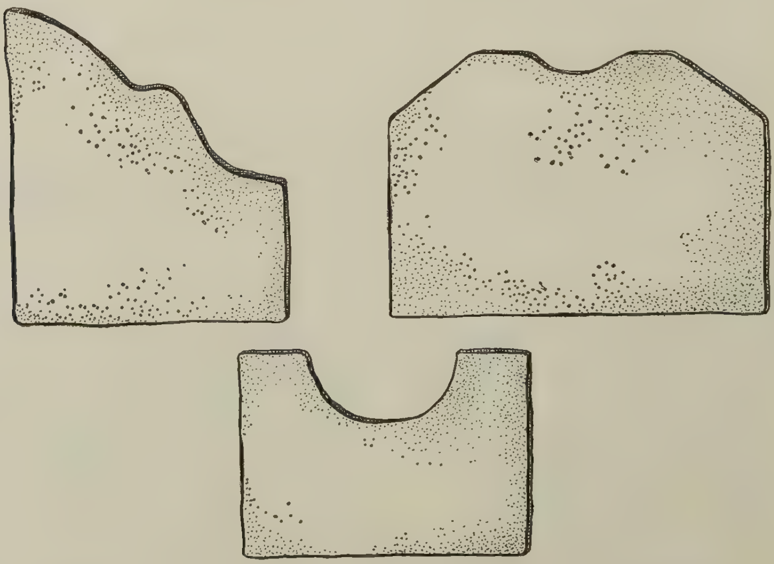

Fig. 405.—Lead-rubber shields used for the treatment of tinea capitis.

Dosages slightly smaller than those necessary to produce an erythema of the scalp will cause temporary epilation. Our epilating dose follows that outlined by MacKee, being obtained from a modern apparatus with Coolidge universal type broad focus tube operating at 100 kv. (6-inch spark gap), 3 ma., for an exposure time of two minutes at 8-inch anode-skin distance. When the distance is decreased to 6½ inches for the treatment of unusually small heads, the factors which give an equivalent dosage are 100 kv. (6-inch spark gap), 3 ma., for an exposure time of one minute and fifteen seconds. Even in the treatment of very small heads the distance between patient and tube terminals should be greater than the length of the spark gap. Variations in the amount of overlapping due to differences in the size of heads are controlled by changes in the anode-skin distance. Heads with a circumference of 20 inches or over are treated with an 8-inch skin-target distance. For heads with a circumference of 19 inches it is advisable to use a skin-target distance of 6½ inches in order to avoid too much overlapping. When the head is smaller than this, the dose should be slightly reduced. Adult heads with a circumference of 22 or more inches require a slightly larger dose. It is sometimes advantageous in adults to use a skin-target distance greater than 8 inches, or even seven instead of five areas.

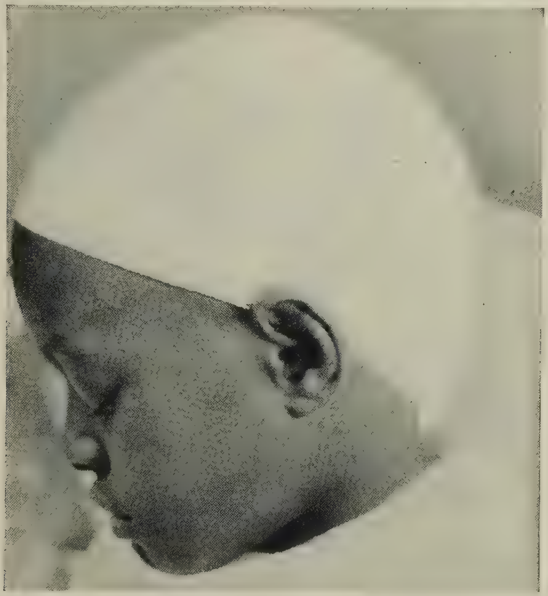

Fig. 406.—Adhesive cap which is applied the seventeenth day after *x*-ray treatment, being burned when removed in order to prevent the spreading of infection to others.

After proper dosage the hairs begin to loosen, and fall in about seventeen days, carrying with them numberless spores. In order to prevent needless spreading of the disease at the time of *defluvium*, patients under treatment are instructed to wear white head coverings, which are easily made from paper bags or the tops of white stockings. These are changed daily, the used ones being burned. About the seventeenth day when the hair is loose, the scalp is covered with adhesive plaster to form a skull cap. This is left in place over night and the following day is pulled off and burned, the loose hairs being pulled out with the adhesive cap. If the epilation has been completely successful, the scalp is then hairless. However, a complete defluvium is not imperative for a cure in the majority of cases.

There is a considerable *margin of safety* between the epilating dose and that which causes permanent alopecia. Occasionally the hair will fall out after $\frac{3}{4}$ of an epilating dose, but there have been no cases of permanent alopecia in our experience. It probably requires $1\frac{1}{2}$ E. D. or more to cause permanent alopecia. A mild erythema appearing a week after treatment and lasting two or three weeks has resulted in the reappearance of the hair without more than slight delay. Probably if second degree reactions with exudation were produced, the regrowth would be sparse and of poor quality, but I have never seen such reactions although the work in our clinic has been done by numerous postgraduate students and technicians, always, of course, under careful supervision. *x*-Ray treatment is sometimes erroneously held responsible for scarring and permanent destruction of the hair follicles in small areas caused by the disease itself. To avoid any injustice or criticism on this point it is recommended that the parents of all patients with suppurative deep lesions should be told of the possibility of slight scarring before any treatment is given.

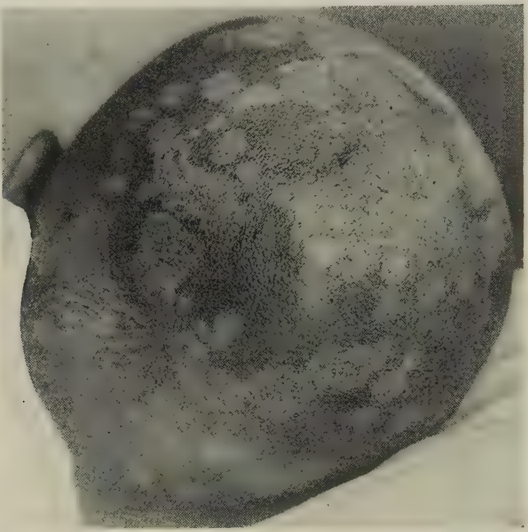

Fig. 407.—Tinea capitis after epilation. Mild antiparasitic ointments are now applied.

x-Ray treatment causes the hair to fall out, but has no direct effect upon the fungus, except that when the hairs fall the fungi which inhabit them are simultaneously removed. Immediately after epilation, antiparasitic remedies are instituted to destroy the few spores which remain in the hair follicles and on the scalp, with the purpose of avoiding relapse and reinfection. Remedies are more effective if all crusts are removed prior to their application by the use of a paste composed of 4 tablespoonfuls of starch mixed with a little cold water and then stirred continuously while 1 pint of boiling water is added, so that a jelly is formed. To this, 1 teaspoonful of boric acid and 1 tablespoonful of glycerin are added. A wet dressing of this paste is applied to the crusted scalp for four to five hours, and then it is washed off. Of antiparasitic remedies 5 per cent sulphur ointment and 5 per cent ammoniated mercury ointment are popular, the former being preferable. The strength of these *ointments* is gradually increased until all signs of infection have disappeared. It is often necessary to increase the strength of the sulphur ointment to 20 per cent, especially on incompletely epilated scalps, and even the addition of tar or salicylic acid is sometimes of value. In infected cases wet dressings of solution of aluminum acetate or ammoniated mercury ointment are indicated, and small fluctuating abscesses must occasionally be incised and drained. During the entire treatment the scalp should be shampooed every morning and the local medications should be applied afterward, as well as at bedtime.

Regrowth of hair is noticeable from two to four months after epilation. This interval is of importance in allowing sterilization of the follicles to take place before the new hair forms. Tschernogubow has stated that there must be a depression of the activity of the papilla following the epilation dose as otherwise the new growth of hair would appear at the surface in twenty days. The regrowth may appear earliest and thickest in the areas which were diseased and may vary from the original hair as to texture, shade of color, or curliness.

A *cure* is assured if the epilation was complete and the scalp was rid of clinical evidences of the disease by means of antiparasitic remedies before the regrowth of hair became visible. However, many patients who do not fulfil these requirements are also cured. Of this group the most unfavorable are those in whom the hair regrows before the scalp is free of lesions. Before being discharged all patients who have any questionable areas should have a microscopical examination, preferably done two weeks after the stopping of local remedies.

The *failures* to obtain complete epilation are usually due to excessively short anode-skin distance, insufficient clipping of the hair before the exposure, thus filtering out some of the radiation, or unskilful focusing, with resultant errors in the overlapping. Whenever residual tufts of hair persist after epilation, particular care must be exercised for they are common causes of failures. Sometimes small fringes of hair persist on the back of the neck, about the ears, at the anterior margin of the scalp or vertex, this residue always being an evidence of imperfect technic or restlessness of the child. It is not a safe procedure to give further x-rays to such tufts; even the minutest ones must be epilated by forceps. Failures to cure may also result from reinfections from other children, old hats or pets, especially cats, dogs, and canaries.

In case of failure to epilate the scalp *repetition* of roentgen-ray treatment cannot safely be made for at least four months, when an epilating dose may be given again, with special precaution to avoid the mistakes which led to difficulty in the first attempt. When epilation has been more or less thorough, but the disease is not cured due to neglect of such precautions as manual epilation of a few persistent hairs or the thorough use of ointments, or due to a reinfection; six months should elapse between the first and second x-ray treatments.

Until comparatively recently the opinion was generally held that it was unwise to treat ringworm of the scalp by x-rays in *children under three years of age*. Apart from the possible risk of such a procedure to the brain, there was the practical difficulty of keeping the child immobile during the exposure, and any form of restraint by the operator or attendant involved too much danger to them to be advocated. MacLeod, however, has reported 276 cases in which the patients were treated by this method, utilizing a special couch and calico helmet for immobilization. He has also endeavored, by means of pastille measurement, to estimate the screening capacity of the infant skull, scalp, and dura mater.

In the experiments he used a standard Coolidge tube with a fine focus, a 16-inch coil running on 100 volts D. C. with a mechanical rectifier, the spark gap being 25 cm. with a 2 ma. current in the secondary circuit. The dosage was estimated by Levy pastilles, certified by the National Physical Laboratory, an 8 c. p. carbon-filament electric lamp being used to compare the pastille with the standard tint B of a tintometer. In addition, a tachymeter, or interruption counter, was employed, which, owing to the constancy of the irradiation from the Coolidge tube, was a valuable check on the pastille, once the original pastille had given the arbitrary figure on the tachymeter at which it was turned to tint B. The following experiments and conclusions are taken from the article:

"Experiment 1.

"In it three pastilles were exposed:
"A. At 22 cm. distance from the anticathode, screened by scalp, skull, and dura.
"B. At 22 cm. distance, unscreened.
"C. At 11 cm. distance, unscreened.

"Pastille A required 8 pastille doses at C to turn it to tint B, and pastille B 4 doses at C. This showed that the screening capacity of the above tissues at 22 cm., the normal working distance of the scalp from the anticathode of a Coolidge tube, reduced the irradiation by about 50 per cent.

"Experiment 2.

"In it two pastilles were exposed:
"A. At 11 cm. distance, screened by scalp, skull and dura.
"B. At 11 cm. distance, unscreened.

"The screened pastille at A required two pastille doses at B to turn it to tint B. This corroborated Experiment 1, and showed that the tissues reduced the irradiation which could reach the brain by 50 per cent.

"The screening capacity of the scalp, skull, and membrane of a newborn infant is sufficient, with the above technic, to reduce the irradiation which can possibly reach the brain to about half a pastille dose. This dose is harmless to the skin, a tissue which is highly reactive to the *x*-rays, and should be even more innocuous to the brain and nerve tissue generally, which, being highly specialized fixed tissues, are much more resistant to the rays than the skin."

Kerion (ringworm of the scalp) is usually localized, but occasionally several lesions are scattered over the scalp, in which event the child may have fever and other toxic symptoms. All patients should be irradiated without delay, because as soon as epilation occurs relief is obtained. Extensive involvement with abscesses is not a contraindication to roentgen therapy.

Favus (porrigo scutulata, porrigo lupinosa, tinea favosa) is not indigenous to this country, but is to be found among the Russian, Polish, or Italian immigrants of any age. It is generally caused by the Achorion schönleinii. The disease appears chiefly upon the scalp, but may affect the glabrous skin and the nails. The characteristic lesions are sulphur-yellow or saffron, pinhead to pea sized, cup-shaped crusts, called scutula, each of which is usually pierced by a hair. The scutula are often imperfectly formed, and appear as scattered grayish-yellow specks or in thick yellow clusters; or through coalescence, as extensive thick, dirty yellow adherent crusts. They have a mousy odor, which is fairly distinctive. On the glabrous skin the patches form thickly crusted yellowish disks, which through fusion and peripheral extension may cover large areas. The lesions are frequently multiple and even numerous, and they have a tendency to simulate ringworm, forming rings which, however, may be surrounded by an inflammatory halo. When the nails are affected, they become brittle, discolored, irregularly thickened and under the free margin there are collections of crusts. Clinically the appearance is generally not distinguishable from other forms of onychomycosis. When the scalp is involved, the hairs in the patches become dry, lusterless, wiry, and loose, and about their bases are convex sulphur-yellow scutula.

As the disease progresses, alopecia and scarring supervene, often associated with suppuration. The scars are, as a rule, white and depressed, and similar to those which occur in papulonecrotic tuberculide. The atrophy causes a smooth, glossy, thin, paper-white, hairless patch, even the follicular orifices being absent. These patches are generally irregular in shape, with a tendency to be more or less oval, and they may be small or large and of any number.

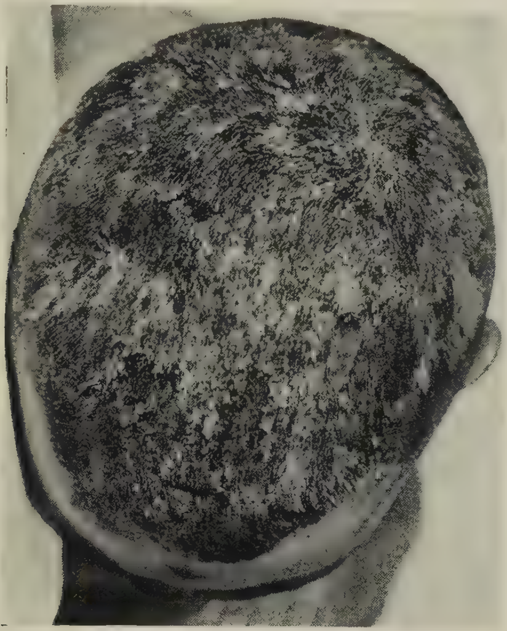

Fig. 408.—Favus of the scalp.

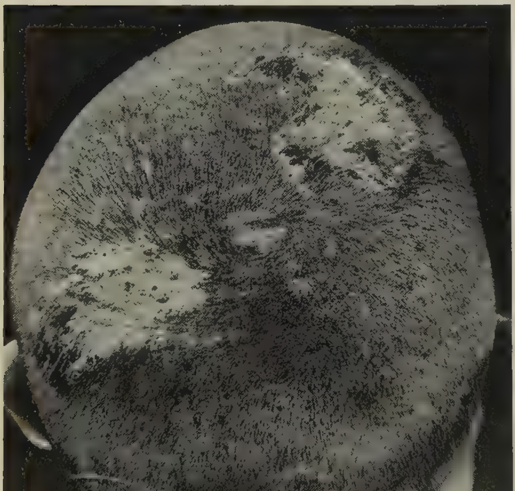

Fig. 409.—Favus of the scalp, showing scutula.

Occasionally these characteristics are absent, and the clinical appearance simulates trichophytosis, seborrheic dermatitis, psoriasis, lupus erythematosus or folliculitis decalvans, and staphylococcic dermatitis associated with pediculosis capitis. Its differentiation from ringworm and seborrheic dermatitis has been given under ringworm of the scalp. In staphylococcic infections associated with pediculosis capitis there is intense itching, with pyodermia, impetigo, and furunculosis.

Favus of the body responds readily to antiparasitic remedies such as are used in the treatment of ringworm. The chief ingredients are sulphur, and salicylic acid or iodine. Treatment of favus of the nails follows the methods described for other forms of onychomycosis.

Favus of the scalp is treated in the same manner as ringworm of the scalp, with the exertion of extraordinary care, however, because the disease is much more difficult to cure. Treatment by medicinal means is unsuccessful, and x-ray epilation is the most satisfactory method, although failures are not infrequent. The technic is similar to that described for tinea tonsurans, except that thick crusts should be removed by a soap poultice before irradiation is applied, as they would otherwise absorb a considerable fraction of the dose. The epilation must be complete. Whereas in ringworm of the scalp cures often follow partial epilation, recurrences always ensue in favus under such a condition. Even the smallest tufts of hair must be epilated, manually if necessary. Strong sulphur ointment (20 per cent) must be applied immediately when the hair has fallen and must be continued daily, so that all clinical and microscopical evidences of the disease disappear before the hair regrows. As favus is likely to cause atrophy and permanent baldness, the physician should acquaint the parents of the patient with the possibility of these sequelae and should urge x-ray treatment at once to avoid them as much as possible.

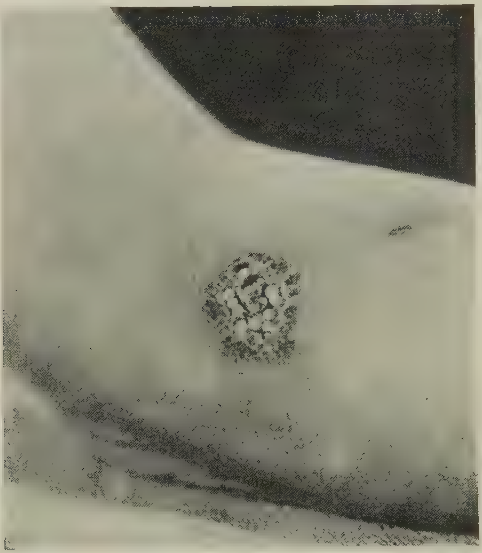

Fig. 410.—Favus of the arm. Note the individual cup-shaped lesions. (Courtesy of Dr. A. B. Cannon.)

The *results of x-ray epilation* of ringworm and favus of the scalp are uniformly satisfactory when applied by specialists with training and experience. Statistics of results at many large clinics are not at hand, but the general approbation is confirmed by these figures. In the last ten years, at our clinic, over 2500 cases (mostly microsporon) have been successfully epilated by unfiltered *x*-rays without a single case of permanent baldness or injury of any nature. No headache, vomiting, fainting, or other signs of brain injury have been observed by me, although I have been in close touch with most of the patients. Nemenow, director of the Institute of Roentgenology and Radiotherapy at Leningrad, reports 3351 patients (among them 2301 suffering from ringworm and 1050 from favus) treated by *x*-rays since 1907, he secured nearly 100 per cent of cures with almost total absence of complications. There is no longer any doubt that the ideal method of producing a total epilation of the scalp in the treatment of ringworm and allied conditions is by means of *x*-rays in the hands of an experienced dermatologist, yet some patients live a long distance from a treatment center, and in other instances the parents show an unwarranted fear of *x*-ray treatment. In such circumstances, and some to be mentioned later, epilation may be produced by the internal administration of *thallium acetate.*

The use of thallium acetate for epilation of children with tinea capitis is now an accepted and standardized method of treatment. Eight milligrams of the acetate of thallium (Kahlbaum) per kilogram of body weight, nude, is the most satisfactory dose for children of all ages. Smaller doses are likely to be insufficient, whereas larger amounts cause toxic symptoms. Accuracy is necessary in the weighing of the child and of the drug. The latter is administered in one dose by mouth, in sweetened water or milk upon an empty stomach. Caro has composed the following table for estimating dosage based on the standard dose of 8 mg. of thallium acetate per kilogram of body weight:

Pounds body weight.	Kilograms body weight.	Grams thallium acetate.
$\frac{1}{4}$	0.1134	0.0009
$\frac{1}{2}$	0.2268	0.0018
$\frac{3}{4}$	0.3402	0.0027
1	0.4536	0.0036
2	0.9072	0.0073
3	1.3608	0.0109
4	1.8144	0.0145
5	2.2679	0.0181
6	2.7215	0.0218
7	3.1751	0.0254
8	3.6287	0.0290
9	4.0823	0.0327
10	4.5359	0.0363
20	9.0718	0.0726
30	13.6077	0.1089
40	18.1436	0.1451
50	22.6795	0.1814
60	27.2154	0.2177
70	31.7513	0.2540
80	36.2872	0.2903
90	40.8231	0.3266
100	45.3590	0.3629

Example: Patient weighs $38\frac{1}{2}$ pounds
Dose for 30 pounds = 0.1089
8 pounds = 0.0290
$\frac{1}{2}$ pound = 0.0018
Dose for $38\frac{1}{2}$ pounds = 0.1397 Gm. of thallium acetate

If larger doses are given, there are neuralgic pains in the muscles and joints, especially the knees, and loss of weight. Other signs of intoxication known to occur in man are choreic convulsions, albuminuria, gastro-intestinal disturbances, achlorhydria, secondary anemia with lymphocytosis and eosinophilia, tachycardia, and in one case a skin eruption. Thallium is excreted by the kidneys, which are particularly liable to injury. Dixon found that in postmortem examinations of animals that have been treated with thallium, the metal is in almost every tissue of the body and can easily be detected spectroscopically. The skin, however, retains less thallium than any other tissue, which is in marked contrast to arsenic. The latter is excreted by the skin, which always contains relatively large amounts. The action of thallium is cumulative, and Devane has shown that it is eliminated after two and one-half months.

The action of the drug in the production of alopecia is apparently selective through the sympathetic trophic nerves and not a direct effect upon the hair papillae. The median parts of the eyebrows, the eyelashes, and the fringe on the forehead, which are not subject to the sympathetic system, are unaffected. The hair at first becomes less glossy, is easily rubbed off and is later shed. Loosening is first noticed seven or eight days after ingestion of the drug, but is usually not complete for sixteen to eighteen days. An adhesive plaster cap is recommended on the eighteenth day to secure perfect epilation. The hair grows again after four weeks, being at first a colorless down, which is followed by a strong growth and finally by complete regeneration after three months.

Thallium is more toxic to adults than to children, epilating doses after the development of puberty being attended at present with great danger. This peculiar fact is probably due to the changed function of the endocrine-sympathetic system after maturity of the sexual glands. Spitzer was able to confirm this observation in animal experiments by finding that the lethal and epilatory doses are much further apart in young than in matured rats.

The use of the drug is also contraindicated in the presence of albuminuria, or, if it fails, a second dose must not be given for some months, as cumulative toxic effects may supervene.

Since thallium salts and roentgen rays apparently produce alopecia through entirely different mechanisms and because of the danger of administering the thallium to adults, Buschke and Langer have developed a technic of *combined thallium and roentgen epilation*, in which the adult receives only one half the thallium dose (4 mg. per kilogram) and also is irradiated with one half the roentgen epilation dose to five areas on the scalp. For grown-ups this method is of some practical value. The possibility of combining both these methods in small doses diminishes the dangers entailed by either one alone.

Occasionally thallium epilation may partly or entirely fail on account of constitutional conditions. The method at best is a substitute for roentgen radiation, which has been employed with complete satisfaction by those skilled in the work as evidenced by the statistics which have been previously given. The number of incomplete epilations or failures to cure from thallium treatment by those experienced with it may be as few as those from roentgen treatment in skilled hands, which belief, however, has not been supported by study of the literature or by my limited use of the thallium method. The greatest field of usefulness for this new method seems to lie in the treatment of severe epidemics of tinea capitis when adequate *x*-ray treatment is not available, and in its combination with *x*-rays for the treatment of adults with diseases of the skin requiring epilation. It is an effective drug with an elective action which produces alopecia, and because of the efficient method of administration worked out by Buschke,[1] Langer, and Peiser, signifies progress in dermatological resources for combating diseases of hairy parts of the skin.

Radium.—Epilation by radium is feasible, having been used for the treatment of ringworm and favus of the scalp by Mazzoni at the Phototherapeutic Institute at Florence, Italy, since 1919. No permanent alopecia has been seen, and none of the early patients show any atrophy of the skin or telangiectasia, satisfactory results having been obtained in a large series. Mazzoni and Palumbo successfully treated 132 patients by a special applicator made in the shape of a cap in which were placed heavily screened tubes. Simpson has a similar device, containing 1 mm. silver tubes distributed so that each square centimeter of the scalp receives about 60 millicurie hours from a distance of 1 cm. The use of radium for this purpose is, however, not advisable if modern roentgen-ray therapy is available, since relatively large amounts of radium and of time must be devoted to the work. I have used radium successfully in the treatment of ringworm of the scalp in very young and restless children, applying flat glazed salt applicators. Success depends greatly upon accurate approximation of the applicator to the skin, for which reason preliminary shaving and specially constructed applicators are very desirable.

Before treatment with the ordinary flat applicators the scalp is divided into squares the size of these by ink or a skin pencil, the lines being ½ cm. broad in order to regulate overlapping. One applicator is sufficient for the entire treatment, but it is preferable to use three or four full-strength applicators in order to shorten the tedious process. These are filtered through 0.5 mm. lead and covered with thin rubber sheeting. They are held firmly against the skin by adhesive plaster strapping, which is at times difficult to do because the scalp is convex, but nevertheless is always very important. Each square area should be treated one hour and fifteen minutes. As the exposure must cover about twenty areas, several sittings are consumed by the treatment.

Following the exposure a mild erythema usually appears after an interval of about five days. This is succeeded in about two weeks by loosening of the hairs, at which time an adhesive plaster skull cap should be applied. Some remnants of hair may persist along the lines between the focus points and these must be epilated manually. As soon as epilation is complete, antiparasitic remedies should be instituted, as regrowth begins in one or two months, and it is necessary to sterilize the scalp in this interval.

TRICHOPHYTIDES, MICROSPORIDES

Favides and Dermophytides.—These terms have been applied recently to acute widespread or generalized eruptions, usually follicular and lichenoid or decidedly scaly, which have been ascribed to general allergy in cases of ringworm of the scalp, favus, and dermatophytosis. The association of trichophytides with kerion was first noted by Jadassohn and for a time it was thought that pustulation was necessary for its occurrence. The eruptions in the beginning were ascribed to an external spreading of the parasites to the general integument, but this view has been discarded on account of the results of numerous experiments. These proved that identical eruptions could be produced in allergic subjects by the injection of trichophytin and that positive blood cultures were common in severe pustular types of ringworm and favus of the scalp. In view of these findings it is now held that this group of eruptions may be produced by the action of fungi brought to the skin hematogenously as well as by the action of their toxins on an allergic skin.

Clinically, the onset is often accompanied by fever, anorexia, and general adenopathy, and sometimes in addition by an enlargement of the spleen and by leukocytosis. The skin manifestations are chiefly on the trunk and extremities, where there occur pinhead-sized, acuminate, flat-topped, or lichenoid, pale or erythematous papules. The appearance of these essential lesions may be modified by being surmounted by minute vesicles, pustules, scales or spines, and at times there are a grouping of the lesions and a tendency to form rings or scaling patches. Rarely the eruptions may be morbilliform or scarlatiniform erythemas, or such as occur in erythema multiforme or erythema nodosum. Conjunctivitis may develop as an allergic phenomenon in association with a generalized trichophytide in a patient with a deep-seated, inflammatory trichophyton infection, just as it does in a tuberculous individual.[1] After a short duration of a few days or weeks there is spontaneous involution, so that treatment is largely symptomatic.

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[1] In 1921 Buschke reported some unusually bad results from *x*-ray treatment of an epidemic of tinea capitis in Hamburg. He had already experimented with thallium epilation, using animals. Buschke, A., and Klemm, G.: Klinische Beobachtungen über die jetzt in Berlin herrschende Mikrosporieepidemie, Dermat. Wchnschr., 72: 453–459, 1921.

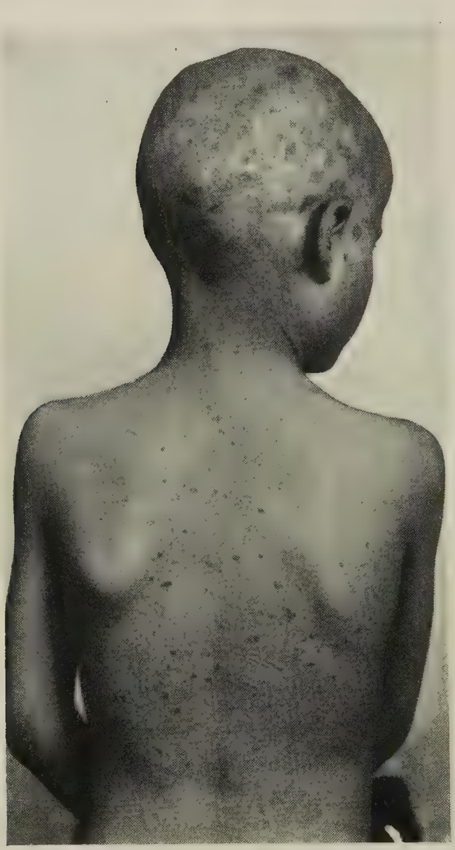

Fig. 411.—Tinea capitis, kerion type with lichenoid trichophytide.

TINEA BARBAE

Synonyms.—Tinea sycosis, barber's itch, parasitic sycosis, tinea trichophytina barbae, ringworm of the beard, hyphomycotic sycosis.

Ringworm of the beard is not a common disease. Two clinical types are distinguished: (1) deep nodular suppurative lesions, and (2) superficial, scaling, partially bald patches. Both types usually begin as superficial scaling patches and their clinical courses parallel fairly closely the depth and extent to which the hairs become involved. The hairs affected are generally loose, dry, and brittle, and when extracted the bulb appears large and white, due to adherent detritus. Frequently there is alopecia in the diseased patches. The deep type of the disease develops slowly and produces nodular thickenings and kerion-like swellings. As a rule, these are confluent and form diffuse boggy infiltrations with abscesses. The overlying skin is inflamed and the hairs are loose or absent and pus may be expressed through the remaining follicular openings. Generally the lesions are limited to one part of the face or neck in male adults, although occasionally they are widespread over the bearded region. The usual locations are the bearded parts of the neck or of one cheek. The clinical diagnosis is confirmed by the microscopical finding of the fungus by the same technic as described for tinea capitis.

Tinea barbae is differentiated from sycosis vulgaris by its occurrence in the mandibular or submaxillary areas, whereas sycosis vulgaris usually involves the upper lip and bearded region. In sycosis vulgaris the lesions are pustules and papules, pierced in the center by a hair which is loose and easily extracted after suppuration has advanced. Parasitic sycosis produces either superficial circinate, scaling patches resembling tinea circinata, or, better known, deep nodules in a circumscribed swollen and erythematous patch within which some of the hairs are loose or broken off, leaving stumps, and microscopical examination of the hairs reveals the ringworm fungus.

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[1] Muende, I.: Conjunctivitis as a Trichophytide Manifestation, Brit. J. Dermat., 42: 26–33, Jan., 1930.

Treatment.—This is along the line of that described for tinea capitis, a combination of roentgen rays and thallium acetate being employed to eliminate the fungus by epilation mechanically. *x*-Rays also have a beneficial action upon the deep inflammatory infiltrations when these are present. No other single remedy is as effective in this disease as irradiation, but the dosage required for complete epilation of the bearded region in adults solely by *x*-rays is sufficiently high to cause some concern. The combination of a half dose of *x*-rays and a half dose of thallium acetate excels treatment by *x*-rays alone. Both are given the same day and together, acting through different mechanisms, produce epilation on the seventeenth day after administration.

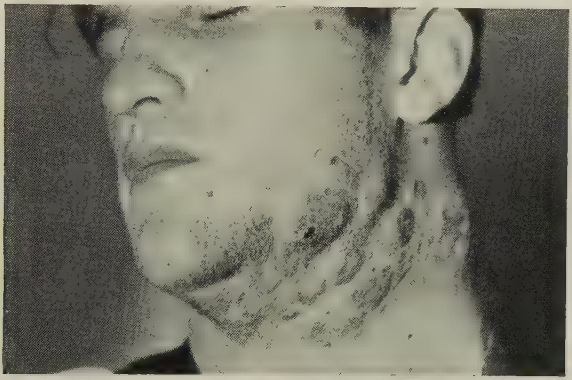

Fig. 412.—Tinea barbae. Note deep nodular swellings. (Courtesy of Drs. J. B. and Bedford Shelmire.)

The patient is weighed, nude, and is given 3 mg. of acetate of thallium (Kahlbaum) per kilogram of body weight in one dose on an empty stomach. He is then treated by *x*-rays. Occasionally even this small dose of thallium causes severe pain in the legs and anorexia for a few days.

Filtration is advisable, especially in the deep type of the disease. With hard radiation there is apparently a greater margin between the epilating and erythema dose, and a better effect upon the infiltrations. Small remnants of hair after epilation, and skin sequelae due to irradiation are less frequent with filtered technic. In fact, heavily filtered *x*-rays seem to give better cosmetic results in this disease than the unfiltered or lightly filtered *x*-rays, because in accomplishing epilation they produce less skin inflammation than the latter. There is, however, more depth effect as evidenced by the occasional swelling of the parotid and submaxillary glands and temporary interference with the salivary secretion.

The technic is modified by the extent of the involvement. Small areas may be treated separately, but in many cases the entire bearded region must be irradiated. Unfortunately, between the time of exposure of isolated patches and the epilation of the hair, there is an interval of at least two weeks, during which new patches may develop. Partial epilation of the upper lip or cheeks usually gives poor results, for which reason it is desirable to epilate the entire bearded region or large parts of it.

The method of Kienböck has been used with general approval. The technic for total irradiation of the chin, upper lip, cheeks, and submaxillary region requires that four tube placements and exposures be made.

1. Over the center of the upper lip.
2. Over the angle of the right mandible.
3. Over the angle of the left mandible.
4. Over the submaxillary region, so focused that an imaginary line from the anode to the tip of the chin will be almost perpendicular to the focus of Exposure 1.

During Exposure 1 and especially in Exposure 4, the head must be retroflexed upon the body. To obtain a suitable position a wide sand bag should be placed beneath the upper part of the back so that the head hangs over it in retroflexion. Sand bags are also used to keep the position of the head steady during all exposures. In Exposure 4 where the tube is over the chest with the anode directed toward the submaxillary region, its proximity to the chest makes thorough protection necessary. The parts of the head above the bearded region, the shoulders, and unaffected portions of the neck are also protected. It is important to shield the eyes and mucous surfaces of the lips thoroughly. If the mustache region is not involved, it should also be given protection. When the upper lip only is affected, it is permissible to limit the exposures to it and adjacent parts by focusing over each corner of the mouth separately, with overlapping and slight modification of the dosage, although, as previously stated, this technic has its drawbacks.

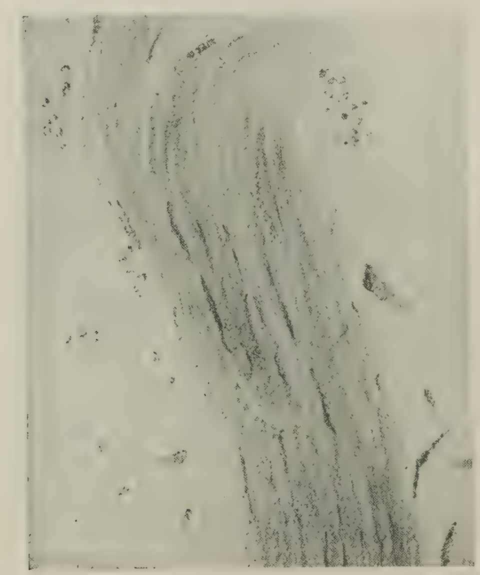

Fig. 413.—Ringworm of beard. Hair showing mycelium and spores. T. gypseum culture. Drawing by Jessie Bodley. (Courtesy of Miss Rhoda W. Benham.)

The anode-skin distance should be sufficient to permit the proper spreading of the beam of radiation and should be the same for each exposure; 10 inches is recommended. Unfortunately the question of dosage of x-rays is not as simple as in the treatment of the scalp because of the numerous convexities and angles of the face and the relative resistance of beard hair to epilation. It often requires a larger amount of radiation to epilate the beard than it does the scalp. Without the use of thallium, usually $\frac{7}{8}$ E. D. is sufficient, the following factors being employed: 137 kv. (9-inch spark gap), 5 ma., 3 mm. aluminum, 10-inch distance for six minutes. This dose is applicable to a single area, but when there are multiple exposures with overlapping it should be reduced to $\frac{3}{4}$ E. D. or about five and a quarter minutes, with the above factors. When combined with thallium, smaller exposures of x-rays are sufficient, from four and one half to five minutes. These alone would be insufficient to produce epilation but when given together with thallium assure complete loss of the beard, and the combination changes a difficult therapeutic procedure to one of comparative ease.

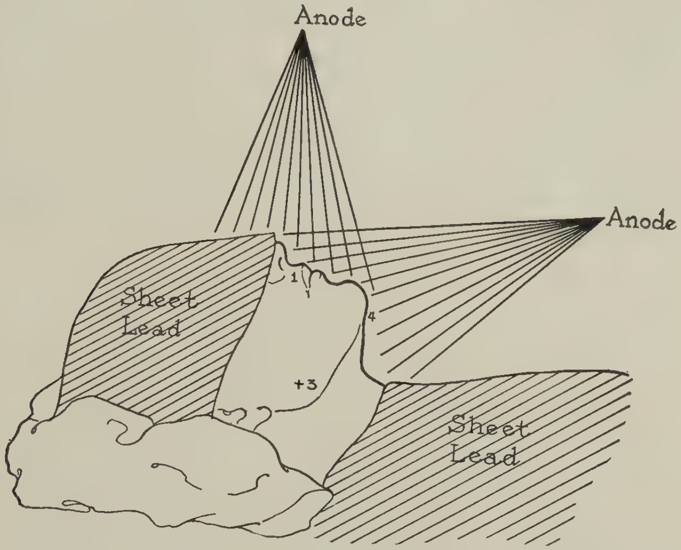

Fig. 414.—Focus points for epilation of the bearded region.

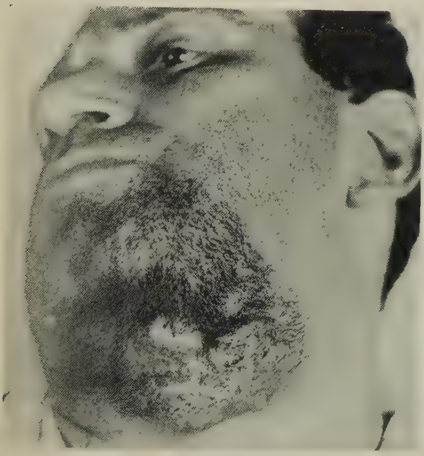

Fig. 415.

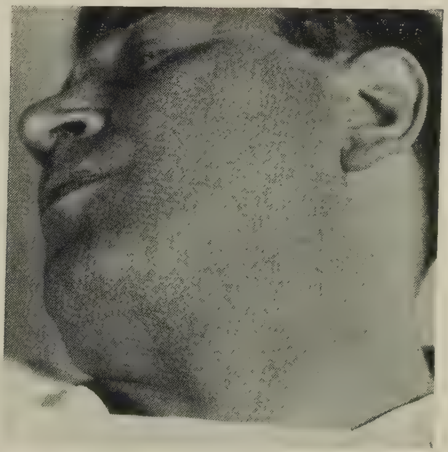

Fig. 416.

Figs. 415, 416.—Tinea barbae. Before and after fractional doses of filtered x-rays (3 mm. Al), without epilation.

Fractional roentgen technic is used by many in the treatment of tinea of the beard. When employed with the Kienböck placements the dosage should be $\frac{1}{5}$ E. D., given through 3 mm. aluminum at two-day intervals for a total of five treatments.

In extensive acute cases there is some danger in giving full doses of x-rays, because they are likely to have a fulminating effect. A few preliminary exposures to ultraviolet light are recommended until the inflammatory process subsides and permits epilating doses of x-rays. The ultraviolet rays may be given daily in doses sufficient to produce a mild erythema. Sometimes the epilating dose of x-rays is ineffectual in causing all the hairs to fall out, in which circumstance those which remain must be removed by forceps. A second exposure of x-rays should not be given for at least two months because of the hazard of radiodermatitis.

After epilation the face should be disinfected by Schlumsky's solution (phenol, 30 parts; camphor, 60 parts; alcohol, 10 parts) or a solution of bichloride of mercury (1 : 1000) in fluidextract of witch hazel. Mild antiparasitic ointments, such as 5 per cent ammoniated mercury ointment, should be freely applied from the beginning of treatment. The parts should be bathed thoroughly in soap and water, and the healthy areas which are not epilated may be shaved or clipped, the toilet articles being sterilized in dilute cresol.

ONYCHOMYCOSIS

Synonyms.—Ringworm of the nails, tinea unguium.

Fungus diseases of the nails are caused by the Epidermophytons, Trichophytons (ringworm and favus), the Saccharomycetes and Monilia. The clinical appearance of all these infections is similar, the exact causative organism being identified by culture. Onychomycosis is usually accompanied by paronychial inflammation and results in malformation and destruction of the nail, which becomes brittle, discolored, lustreless, grooved, and pitted, while beneath its free margin there is an accumulation of epidermal detritus. One of the most important aspects of onychomycosis is its likelihood to serve as a source of reinfection in dermatophytosis of the feet. For microscopical examination a portion of the diseased nail is soaked over night in a 15 per

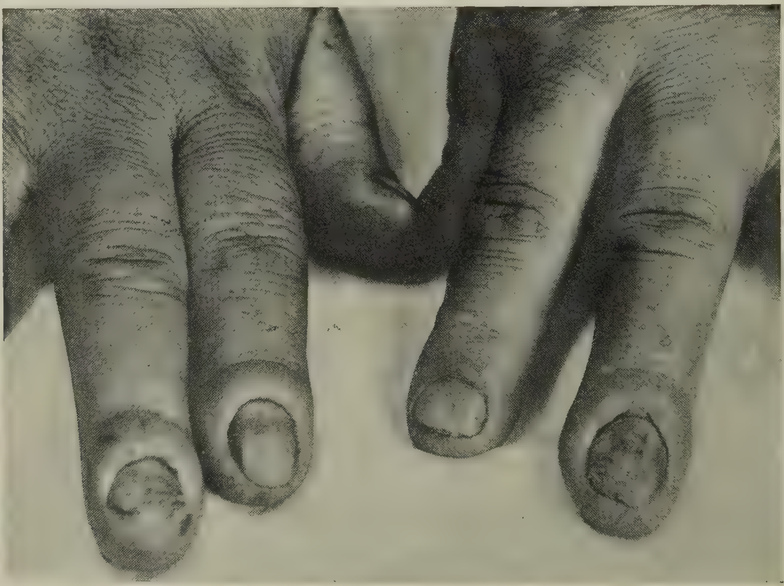

Fig. 417.

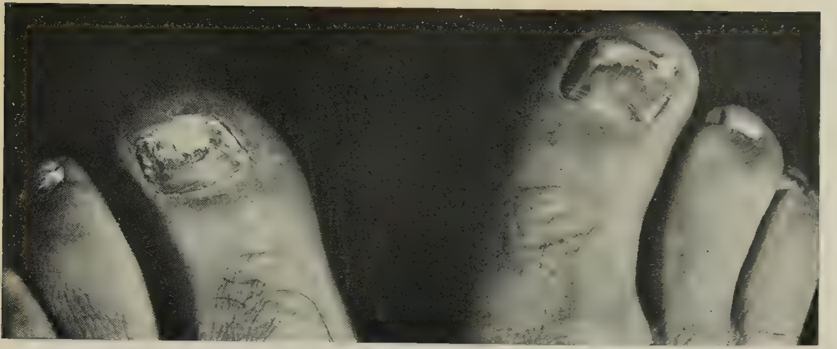

Fig. 418.

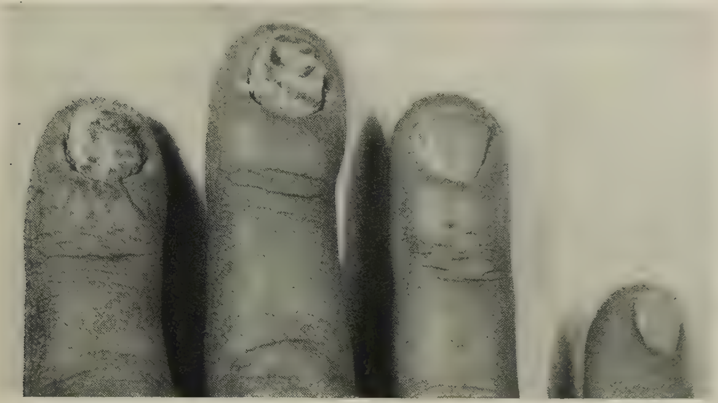

Fig. 419.

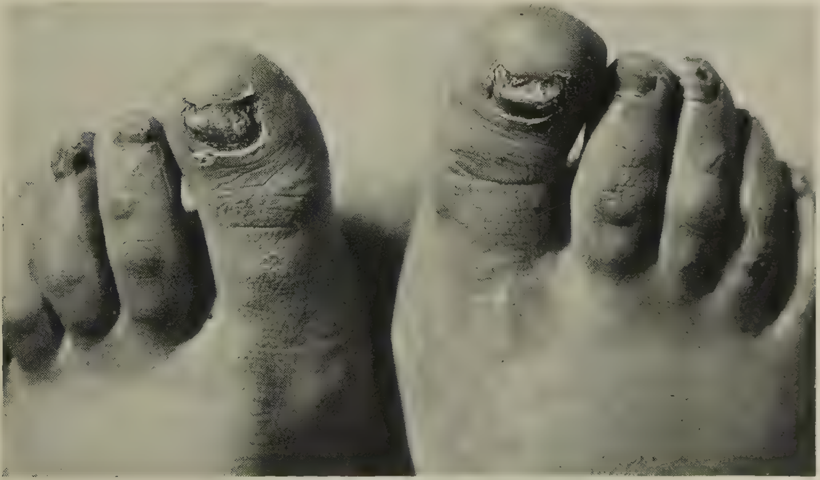

Fig. 420.

Figs. 417–420.—Onychomycosis. Note that affected nails are usually thickened due to heaped-up crusts beneath them, and that they are friable and easily eroded. Paronychial inflammation is commonly present. At times clinical manifestations are trivial.

cent solution of potassium hydroxide and searched for mycelia, spores, and monilia under the high-power dry objective.

Onychomycosis does not usually respond to local medicinal agents. There are two successful methods of treatment: the first, by irradiation, and the second, by surgical removal of the diseased nails.

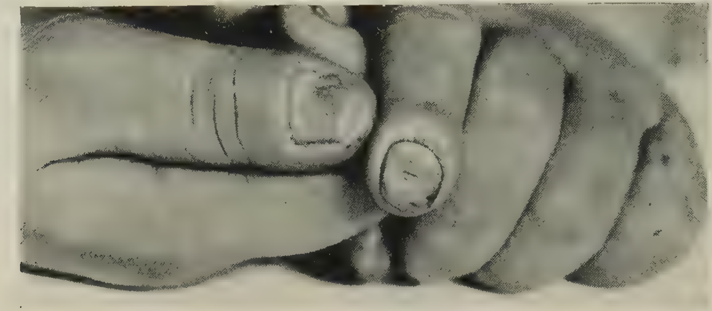

Fig. 421.

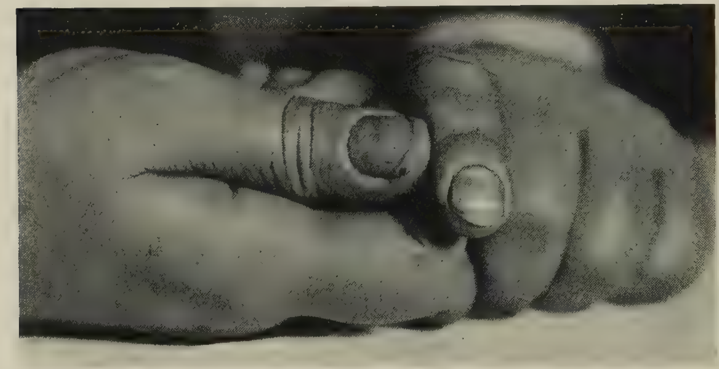

Fig. 422.

Figs. 421, 422.—Ringworm of the nails. Before and after eight fractional doses of x-rays.

In the majority of instances the disorder is curable by fractional roentgen therapy, although the manner of the action is difficult to explain. A separate exposure is given to each affected digit, with complete shielding of all except the distal phalanx. The attempted treatment of two or more nails with one

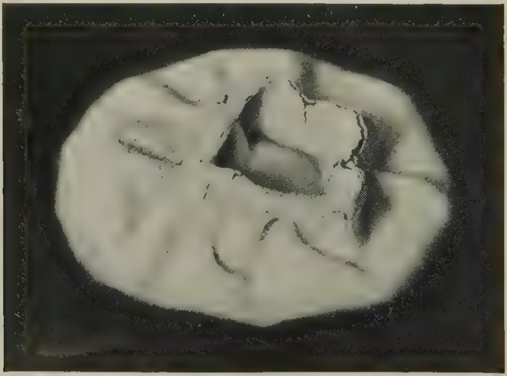

Fig. 423.—Ringworm of nails. Sixteen-day culture on maltose agar, Trichophyton crateriforme. (Courtesy of Miss Rhoda W. Benham.)

exposure leads to inaccuracies and is to be condemned. Filtered radiation seems slightly preferable to unfiltered radiation, the dosage being $\frac{1}{3}$ E. D. at intervals of two weeks or, when unfiltered, $\frac{1}{4}$ E. D. weekly. The parts should be closely watched for evidences of irritability or erythema, and treatment should be suspended if these are suspected. If the condition does not respond to eight or ten fractional exposures, irradiation should be stopped, for additional amounts are not likely to be beneficial and may cause injury. Throughout *x*-ray treatment 3 per cent ammoniated mercury ointment on cotton on an applicator may be rubbed into the cuticle daily. Flat applicators of radium have been used successfully on onychomycosis—half-strength applicators in contact, screened with 2 mm. brass, for from two to three hours at weekly intervals.

In a small number of cases of onychomycosis there is no response to irradiation, and for these surgical removal of the nail is necessary. This method may also be preferred for those who desire more rapid relief than is given by radiation, regardless of pain.

The involved phalanx is prepared by painting with tincture of iodine. The operation is best done under gas and oxygen anesthesia, with an elastic band around the base of the digit to control the bleeding. This method of anesthesia avoids the severe after-pain, puffing, and other undesirable effects of novocaine injections. However, block anesthesia may be obtained by injecting a 1 per cent solution of novocaine into and about the peripheral nerves. A painless procedure is to freeze an area of about a centimeter on the medial and lateral surfaces of the digit at the proximal interphalangeal articulation with ethyl chloride. This anesthetized area is pierced with the hypodermic needles and the tissue between the subcutaneous tissue and the periosteum in this restricted area is infiltrated with novocaine—usually about 4 cc. of a 1 per cent solution being required. Within three minutes anesthesia of the nail and surrounding tissue will be complete.

The edges of the nail are freed with a scalpel. Then the distal end of the nail is grasped with a hemostat and the whole nail is slowly rolled back on itself, exposing the nail bed. Subsequent pain is controlled by morphine if necessary.

After the avulsion of the nail a 5 per cent ointment of iodine in albolene is applied to the nail bed for a week, and then boric ointment is used daily for three weeks. Following this, $\frac{1}{2}$ E. D. of unfiltered *x*-rays is given empirically to the digits bimonthly until three exposures have been made. Regrowth of a healthy nail is usually completed in about five months.

TINEA VERSICOLOR

Synonyms.—Pityriasis versicolor, chromophytosis, dermatomycosis furfuracea.

This common affection is due to the Microsporon furfur, which causes fawn-colored, finely desquamative, guttate, nummular or palm-sized patches. These tend to run together and usually occur on the upper part of the trunk. The individual patches are yellowish or brownish macules, which gradually increase in size and coalesce to form extensive, delicately scaling lesions. At times the surface is smooth, particularly in persons who bathe once or twice a day. In other instances a follicular tendency is a marked feature of the eruption. Rarely the face has been involved, in which event the lesions have resembled chloasma. Mild itching and inflammation about the patches may be present. In brunettes the paler areas between the patches may suggest leukoderma. The fungus is easily demonstrated in scrapings of the scales which have been soaked in 15 per cent solution of potassium hydroxide.

Tinea versicolor must be differentiated from seborrheic dermatitis and syphilis. The diagnosis is generally easy because of the typical fawn color of the patches in tinea versicolor and their distribution on the upper trunk without involvement of the face or scalp. In seborrheic dermatitis the patches have an erythematous yellowish tint and the scales are soft and greasy, whereas in tinea versicolor the scales are furfuraceous. The macular syphilide consists of faint pink lesions, less than a centimeter in diameter, irregularly round or oval, which are distributed principally on the sides of the trunk and flexor aspects of the extremities. A chancre is present, as a rule, and there may be general adenopathy. The Wassermann test is positive in this phase of syphilis, whereas in tinea versicolor microscopical examination of the scales reveals the Microsporon furfur.

The disease responds readily to simple treatment but this must be persistent and thorough to effect a cure, as there is a likelihood of recurrence due to incomplete eradication of the fungus. After thorough washing of the affected areas they are painted with 3 per cent tincture of iodine, or soaked with 10 per cent solution of sodium hyposulphite morning and night. A 2 per cent sulphur and salicylic acid ointment is also beneficial. The applications should be continued until all traces of the disease have disappeared, which is usually a matter of two weeks. Ultraviolet light baths with first degree erythema exposures are likewise an effective means of establishing early and complete eradication of the disorder. Scholtz has reported perfect results from them without the use of any other remedy, and my own cases have seemed improved from such treatment.

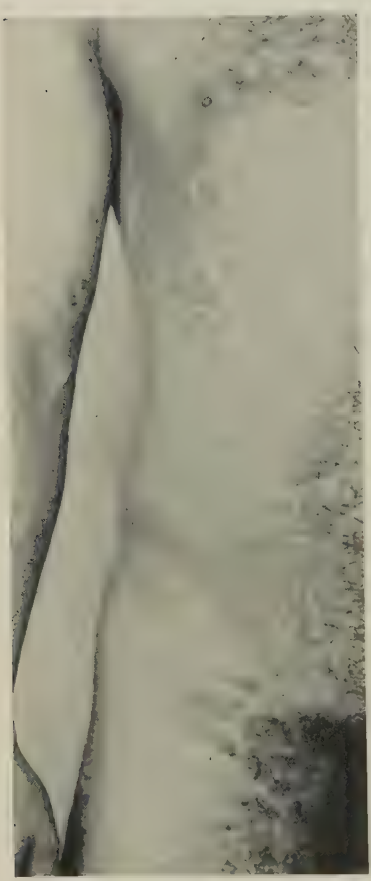

Fig. 424.—Tinea versicolor.

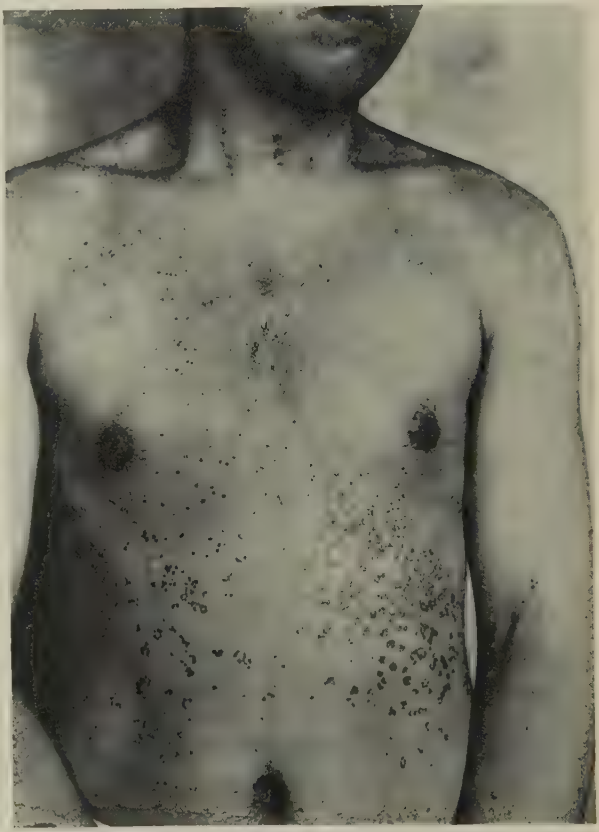

Fig. 425.—Tinea versicolor, guttate lesions.

ERYTHRASMA

Erythrasma is chiefly a tropical affection but is encountered occasionally in temperate climates. The disease is mildly infectious, is due to the Microsporon minutissimum, and is characterized by slowly evoluting brownish, slightly scaly, superficial patches in the groins, axillae, and more rarely in other intertriginous areas. The disease may cause slight itching. It is differentiated from pityriasis versicolor by the brownish instead of the yellowish color and by the absence of any tendency to circinate arrangement, and from pityriasis rosea and crural ringworm, by the absence of inflammation. The treatment is the same as that recommended for pityriasis versicolor.

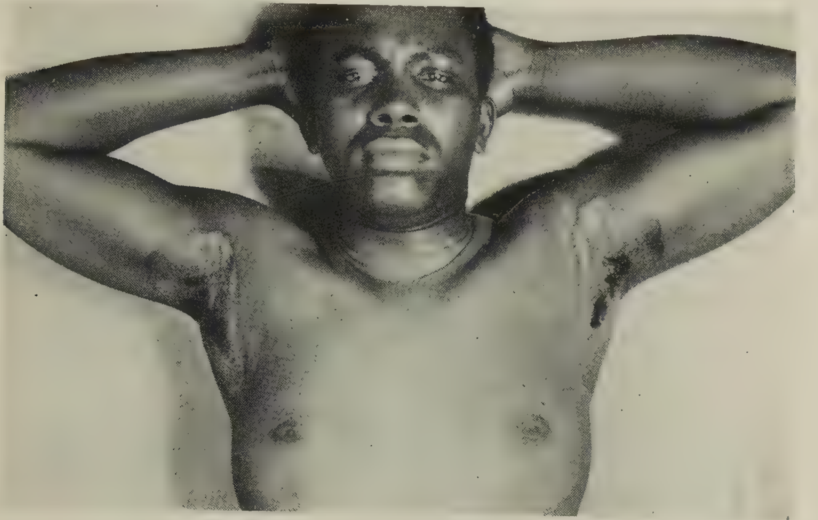

Fig. 426.—Erythrasma.

MONILIASIS

With the increasing number of cases reported each year monilia infections of the skin have become important; they have explained many skin eruptions heretofore considered eczema, and have stimulated the hope of

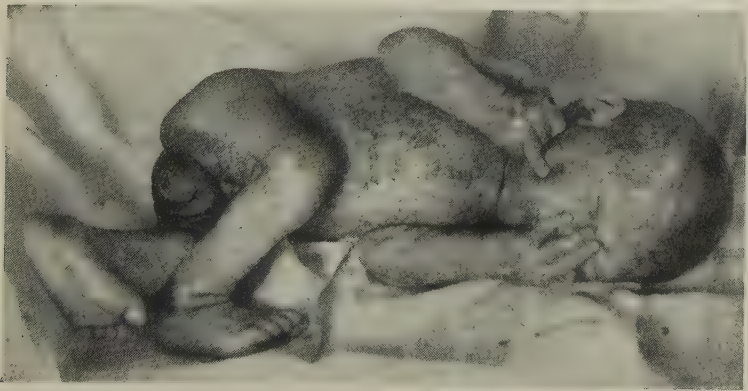

Fig. 427.—Moniliasis (thrush) of the skin. Generalized papulovesicular and crusted eruption in an infant.

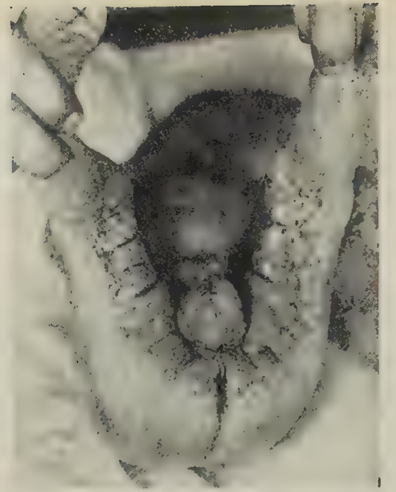

Fig. 428.—A favorite location for thrush in infants.

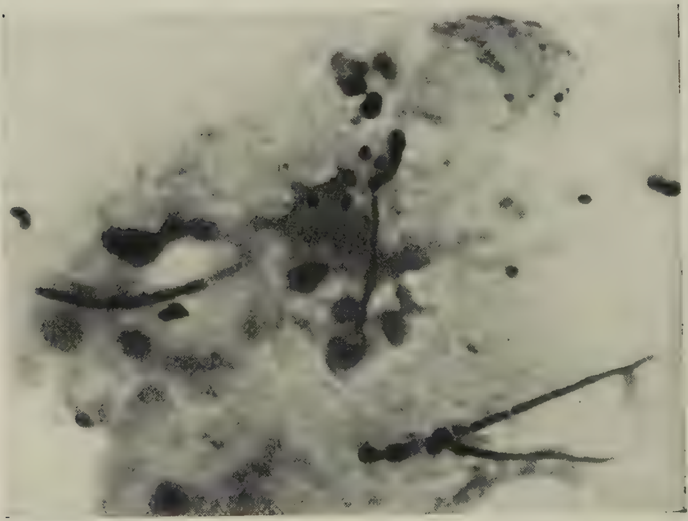

Fig. 429.—Smear from vesicle on ankle showing mycelium in case of thrush of the skin in an infant.

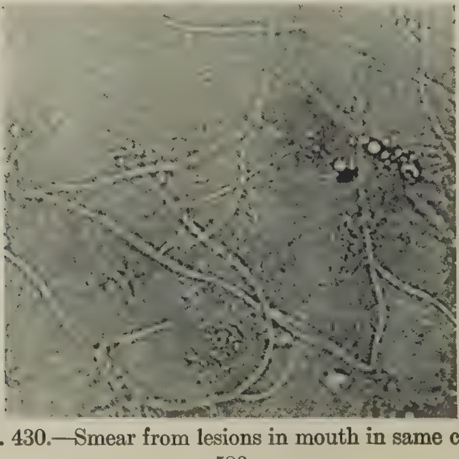

Fig. 430.—Smear from lesions in mouth in same case

further elucidations. While belonging to the normal dermatological flora, Monilia, Oïdia and other yeastlike fungi under favorable circumstances cause lesions of the skin. There may be disseminated papulovesicular, scaling eruptions, or localized intertriginous lesions, which at the onset are inflammatory scaling patches that later extend into configurate plaques or form white sodden, macerated lesions with red moist bases. Ungual and periungual involvement is not uncommon. The tongue and the buccal mucosa are usually affected in infants and sometimes in adults. Engman and Weiss described a case of moniliasis of the buccal mucous membrane in an adult which involved the entire left side of the mouth, including portions of the tongue and hard palate. There was a white glistening, rough pellicle with filiform projections over the affected areas. Finnerud, in a study of perlèche, made cultural studies of scrapings from the angles of the mouth of 100 affected children, and in 77 per cent, organisms believed to be either Cryptococci or true Monilia were isolated. Thrush of the vagina and vestibule, and of the female breast occurs. The Monilia are frequent habitants in the vaginal secretions of pregnant women, to which source the infant infections can be traced. Widespread eruptions are found in nursing infants, in patients undergoing water-bed treatment, and about areas treated by wet dressings. Intertriginous lesions are seen about the anus or genitals, under the breasts, in the axillae and interdigital clefts.

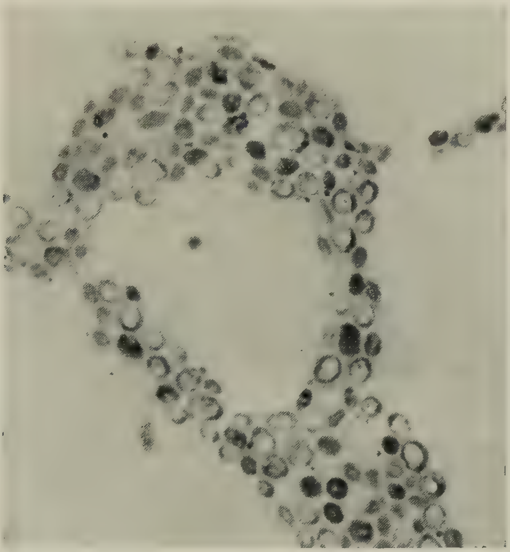

Fig. 431.—Glucose agar culture from skin lesions in same case.

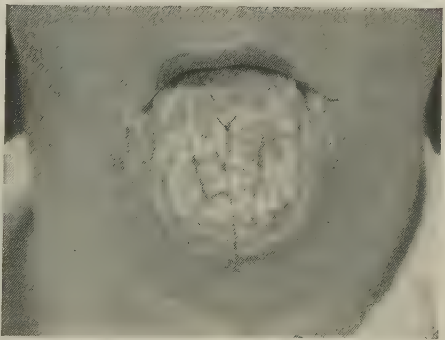

Fig. 432.—Moniliasis of the tongue. (Courtesy of Dr. Kendal Frost.)

The treatment of monilia infections of the skin is usually simple, as most of the eruptions respond readily to iodine, salicylic acid or sulphur.

Widespread eruptions are benefited by ultraviolet light baths. Fractional roentgen therapy is applied to recalcitrant interdigital erosions, which may also be treated by small doses of the beta rays of radium (50 to 75 millicurie minutes per square centimeter or half-strength flat salt applicator in contact, unfiltered, and covered by oiled silk, twenty to thirty minutes). The treatment of ungual and periungual thrush has been described under onychomycosis, page 576.

EROSIO INTERDIGITALIS BLASTOMYCETICA

This is a yeast infection of the interdigits, particularly between the middle and ring fingers, which occurs chiefly in women who have their hands in water excessively. Laundresses, houseworkers, and young mothers are frequent subjects. The lesions are either single or multiple and consist of superficial, well-defined erosions at the edges of which the epidermis is soft, whitish, and loose. The affection is a variety of mycotic intertrigo and in some cases there also are present lesions beneath the breasts, or in other parts where skin surfaces are apposed. The parts should be kept dry and applications made of the following ointment:

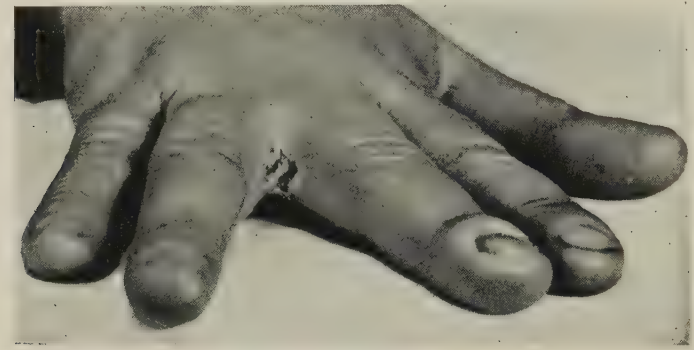

Fig. 433.—Erosio interdigitalis blastomycetica.

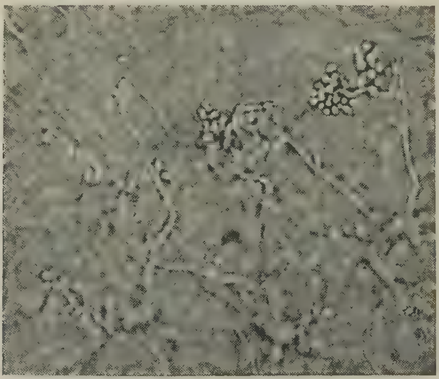

Fig. 434.—Erosio interdigitalis. Monilia. Mycelium and budding cells in skin. (Courtesy of Miss Rhoda W. Benham.)

℞.	Sulphur. praecip.	ʒj
	Acid. salicylic	gr. xx
	Lanolin (toilet)	℥j

M. and S. Apply locally morning and night.

In recalcitrant cases stronger antiparasitic ointments, or alcoholic solution of gentian violet, or, as stated, fractional doses of x-rays are advisable.

FURUNCULOSIS BLASTOMYCETICA

Synonyms.—Furunculosis cryptococcica, folliculitis decalvans cryptococcica.

This is a peculiar type of blastomycosis indistinguishable clinically from ordinary furunculosis. The disease usually occurs on the scalp in the form of a purulent folliculitis with loss of hair. Furuncles indistinguishable from the ordinary variety may also be present on the face and body. In addition to these lesions there may be pustules on the scalp, each of which is pierced by a hair, and nodular or carbuncular infiltrations. The hair in the affected areas falls out and patches of alopecia, sometimes permanent, persist. Paronychia due to the same fungus may be present. Treatment is by large doses of potassium iodide given for long periods. The disease is differentiated from ordinary furunculosis by microscopical examination and by the response to this form of treatment.

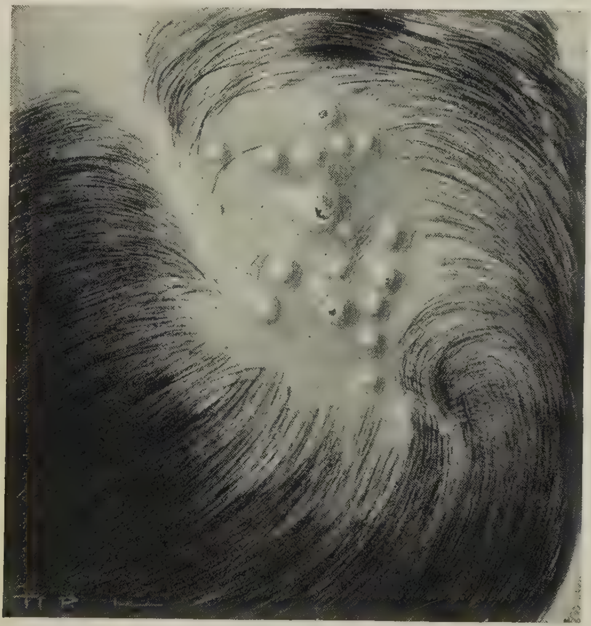

Fig. 435.—Furunculosis blastomycetica. (Courtesy of Sir Aldo Castellani, London, England.)

BLASTOMYCOSIS

Synonyms.—Blastomycetic dermatitis, dermatitis blastomycetica, oïdiomycosis, saccharomycosis hominis.

Cutaneous blastomycosis forms chronic, slowly progressive, granulomatous lesions characterized by thick crusts, warty vegetations, discharging sinuses, and unusual vascularity. The lesions are often multiple, being spread by auto-inoculation, and are located mostly on exposed parts, although they may occur anywhere on the integument. Papillomatous proliferation is most pronounced in lesions on the hands and feet, where the patches become very thick. Frequently there is a tendency for the patches to involute centrally and form white scars while they spread peripherally. The crusts are thick and of a dirty gray or brown color. Beneath them there are exuberant granulations covered with a seropurulent exudate, which oozes out of small sinuses that extend down to indolent subcutaneous abscesses.

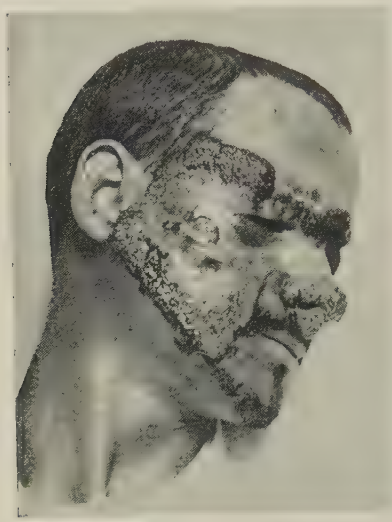

Fig. 436.—Blastomycosis. (Courtesy of Dr. Isaac R. Pels.)

Generally blastomycosis of the skin does not spread to the draining lymph glands or to the blood stream, although systemic dissemination has rarely occurred. Systemic blastomycosis is a progressive, wasting, usually fatal disease, which causes internal abscesses. In this form the skin lesions appear in crops and are superficial or deep abscesses, which break down and give rise to ulcers and fistulae.

Frequently blastomycosis closely resembles tuberculosis verrucosa cutis. It is also to be differentiated from syphilis, drug eruptions, and trichophytic granuloma. The similarity to tuberculosis verrucosa cutis is sometimes so close that it is impossible to differentiate the two diseases by clinical examination, without resort to laboratory procedures. However, the course of blastomycosis is more rapid, and the involvement is more extensive than is common in the verrucous type of tuberculosis. Vegetative lesions of tertiary syphilis usually are accompanied by other signs of the disease and have a predilection for the scalp and the mucocutaneous junctions, areas not com-

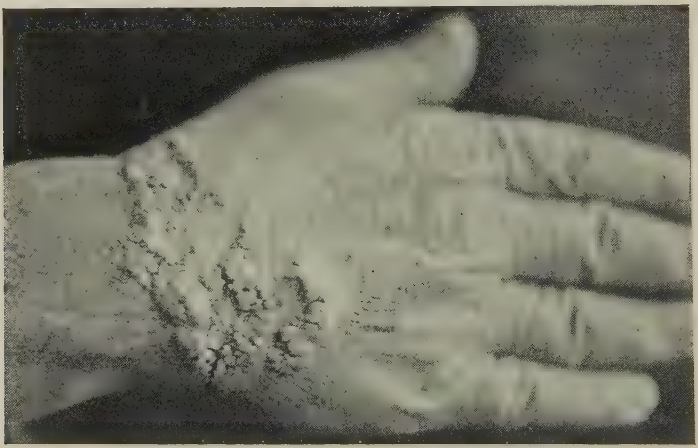

Fig. 437.—Blastomycosis. Note characteristic papillomatous appearance. (Courtesy of Dr. Benjamin F. Ochs.)

monly affected by blastomycosis. Bromide and iodide eruptions are generally more acutely inflammatory and less purulent than blastomycosis. Examination of the tissue or of smears from the exudate, together with the history, will determine the diagnosis. In deep trichophytic granuloma the duration is, as a rule, less than in blastomycosis, and the lesions are not so papillomatous. Microscopical demonstration of the causative fungi is conclusive. Sporotrichosis is characterized by subcutaneous abscesses which are distributed along lymphatic channels, the overlying skin becoming involved only secondarily.

By the use of iodides internally or roentgen therapy, or a combination of both, the treatment of cutaneous blastomycosis is fairly satisfactory. The oral administration of large doses of potassium iodide (100 to 200 grains a day) causes brilliant results in some cases and seems to have a decidedly inhibitory effect on the development of the organism and its ravages. Yet rarely, if ever, has the continued use of this drug led any patient to a satisfactory recovery.[1] Potassium iodide was the most effective remedy for the disease prior to the use of roentgen rays, but at the present time the latter are acknowledged by most dermatologists as the method of choice. The results from unfiltered *x*-rays are generally satisfactory, cures being attained in most cases. The dosage may be fractional or intensive; the result is essentially the same with both methods, because the fractional doses are repeated at shorter intervals. When the papillomatous changes are pronounced, filtration through 3 mm. of aluminum is advisable. For such very thick patches, which are usually on the hands and feet, Desjardins has recommended preliminary removal by surgical diathermy to hasten regression. "By means of the monopolar or Ouidin current the thick patches can be dealt with much more rapidly, and much time can be saved. It is advisable not to attempt to do too much at one sitting, that is, one should not aim to

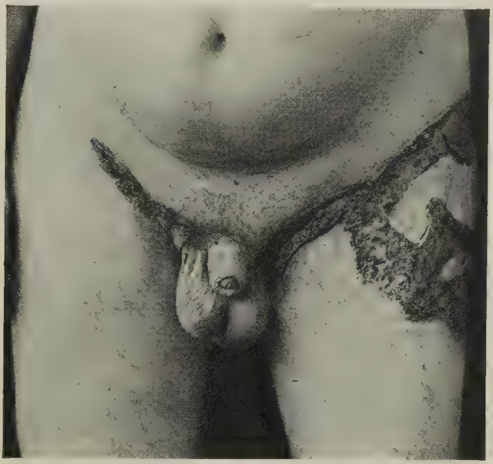

Fig. 438.—Blastomycosis, resembling granuloma inguinale. (Courtesy of Dr. Arthur U. Desjardins.)

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[1] Hyde, J. N., and Ricketts, H. T.: A Report of Two Cases of Blastomycosis of the Skin in Man, with a Survey of the Literature of Human Blastomycosis, J. Cutan. Dis., 19: 44–59, 1901.

destroy the entire thickness of the lesion, especially if it is located over a mass of tendons, such as on the dorsum of the hand. Too much zeal in such a case might prove unfortunate. Not only can the larger patches be destroyed, but the tiny pustules scattered around in the older parts of the area can be attacked individually.

"The only difficulty associated with such work is that of anesthesia. The verrucous tissue is quite spongy, so much so, indeed, that novocaine seeps out as rapidly as it can be injected. In some cases it is possible to block the area by a ring of subcutaneous infiltration well beyond its margins. In others, a block of the extremity may be necessary."

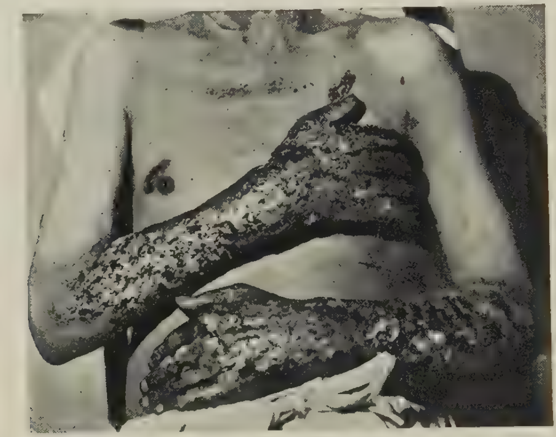

Fig. 439.

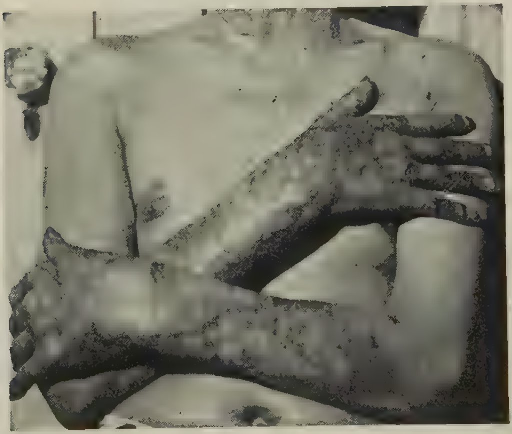

Fig. 440.

Figs. 439, 440.—Blastomycosis. Before and after treatment with potassium iodide. (Courtesy of Dr. Lawrence K. McCafferty.)

Jackson has applied surgery successfully to extensive blastomycotic skin lesions. It is a reasonable method prior to irradiation. The choice between surgical diathermy and the scalpel would seem to be largely a matter of individual preference guided by the circumstances in each case.

A judicious combination of the above methods of treatment gives the most rapid result. Although cures of blastomycosis have also resulted from ultraviolet therapy and from the use of radium, they are more of academic than of practical interest, for the other remedies are generally preferable.

"As an illustration of results that may sometimes be obtained by the use of systemic, or long wave ultraviolet radiation, mention may be made of at least one case of generalized blastomycosis which was cured by this agent alone. The causative fungus in this case was recovered from several skin lesions. The roentgen findings in the chest were very similar in appearance to those of tuberculosis. There could be no possible doubt of the diagnosis. Because this patient's blood picture showed only 3,400,000 red cells, and hemoglobin 65 per cent, ultraviolet radiation was advised; but only with the hope that it would improve the blood picture, and help to further combat the infection. All other treatment was discontinued. After twelve treatments in twenty-four days the blood count showed 4,500,000 red cells, and the patient's general appearance had entirely changed—the chronic abscess had nearly healed, and the cough was much improved. Treatment was continued for about three months, at the end of which time the patient had entirely regained his weight, was symptom-free, and apparently in splendid physical condition. This treatment was given about two years ago. The patient is still in splendid condition and is working every day.

"One other case of systemic blastomycosis is said to have been cured by a year's residence at a Florida bathing beach. It was thought at the time that sea bathing accomplished the cure, but in the light of the case just mentioned, restoration to health was in all probability brought about not so much by sea bathing as by sun bathing."[1] Simpson, Pinch, New, Benedict, and others have cured blastomycotic skin lesions completely by radium therapy.

COCCIDIOIDAL GRANULOMA

Coccidioidal granuloma is a disease which is endemic in Southern California and occurs sporadically in other parts of the country, and which produces cutaneous lesions that resemble blastomycosis. Systemic involvement and a fatal outcome are not infrequent. All observers agree that coccidioidal granuloma is caused by a specific fungus, and affects chiefly adult males (usually laborers), though 29 cases have been reported in women. It is a disease of both man and animals. The primary lesions are generally either in the skin or in the lungs.

The early skin lesions are furuncular and, as a rule, are located on the hands or arms, where they may remain localized for several years. They are indolent and eventually suppurate with the formation of numerous sinuses, and may resemble the more acute forms of cutaneous tuberculosis. They may also have the appearance of the lesions of mycosis fungoides. Some cases with painless subcutaneous abscesses resembling gummas have occurred, while in others the picture has been that of glandular tuberculosis. The disease spreads slowly and causes considerable scarring.

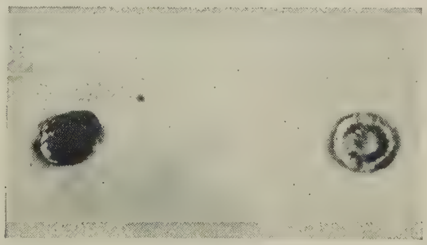

Fig. 441.—Coccidioidal bodies found in pus from sinuses. (Courtesy of Dr. J. F. Burgess, Montreal, Quebec.)

The diagnosis is made by finding the causative organism, which has distinctive microscopical features. This may be seen in direct smears from the pus, appearing as double-contoured yeast cells of various sizes. With proper staining the outer envelop of the larger cells shows fine filamentous processes connecting with the central medulla, which in the smaller cells appears homogeneous, but in the larger ones occasionally is coarsely granular. The organism multiples by endogenous spore formation; budding has not been observed. Its growth in cultures is exceptionally slow and difficult.

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[1] Lawrence, W. S.: Ultraviolet Radiation, Am. J. Roentgenol., 15: 246, March, 1926.

When injected into mice it produces abscesses in which the typical coccidioidal bodies may be demonstrated. Histologically, the lesions in man are granulomas. The essential lesion occurs in the deep cutis, especially about the hair follicles and sweat glands where there is a collection of lymphocytes, endothelial cells, and varying numbers of giant cells.[1] Presumably the disease is transmitted by the handling of raw fruit. Treatment is by the internal administration of potassium iodide, which in some cases is ineffective. Radiotherapy should also be tried.

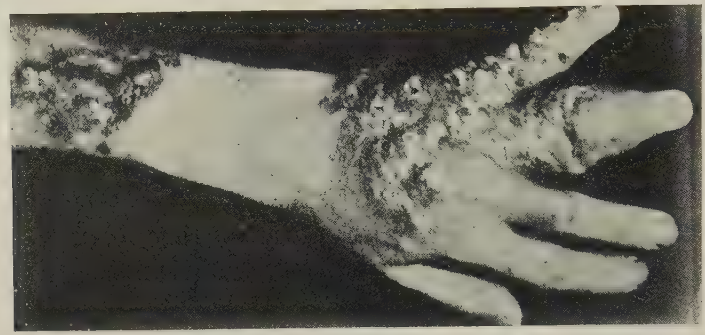

Fig. 442.—Coccidioidal granuloma. (Courtesy of Dr. J. F. Burgess, Montreal, Quebec.)

ACTINOMYCOSIS

Synonym.—Lumpy jaw.

Actinomycosis of the skin is usually secondary to disease of underlying bone or periosteum caused by the "ray fungus," although rarely the skin may be infected from external sources (infected animals, cereals, hay, and straw). The most common site of involvement is the cervicofacial region, to which the fungus may spread from carious teeth, disease of the inferior maxilla or infected gums. Next commonly the disease occurs along the midline of the back secondary to disease of the vertebrae. The lesions of

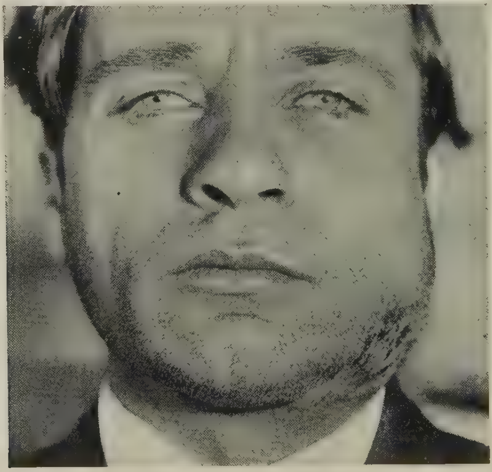

Fig. 443.—Actinomycosis.

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[1] Burgess, J. F.: Coccidioidal Granuloma, Brit. J. Dermat., 41: 145–148, April, 1929.

actinomycosis are rather characteristic, being local dusky-red swellings, deep fluctuating nodules, and sinuses exuding a purulent discharge, which contains tiny whitish or yellowish granules that are masses of fungi. The process is sluggish and begins insidiously. The earliest lesions are firm purplish nodules, which gradually soften. Generally the involved area is limited, being palm sized or smaller, but rarely may be extensive or even widespread. The aggregation of lesions is usually surrounded by marked induration which is adherent to the underlying structures. The tongue is a rather common site of the disease. Men are more commonly affected than women; those in certain occupations, particularly grooms and drovers, being predisposed. Clinically actinomycosis must be differentiated from scrofuloderma, which is more likely to occur in sickly subjects and to cause less infiltration and more corded and hypertrophic scars. Upon superficial examination, sarcoma, carcinoma, blastomycosis, and tertiary syphilis are other diseases that may be suggested, but are readily excluded by a close study of the characteristics of the lesions. Positive diagnosis is made by a demonstration of the fungus in the discharge—which is usually a simple matter—or in sections from the edge of the lesions.

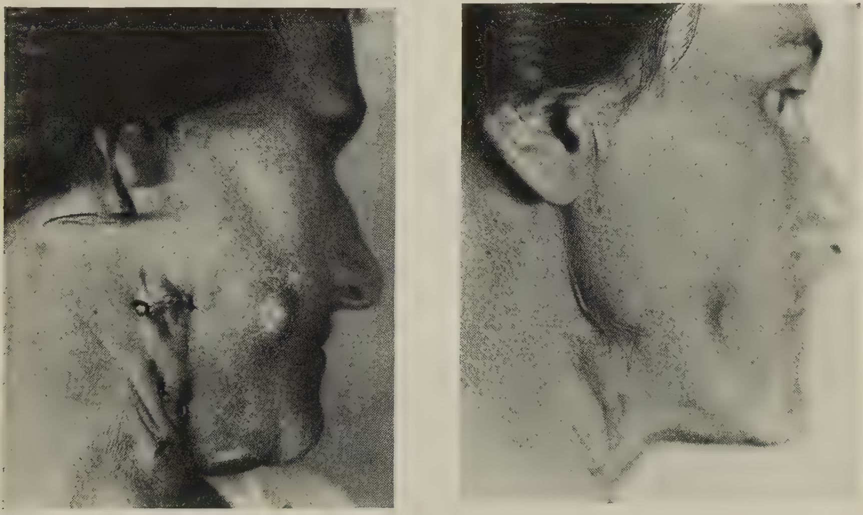

Fig. 444. Fig. 445.

Figs. 444, 445.—Actinomycosis, which developed after extraction of a carious tooth. Patient shown before and after one suberythema dose of x-rays, filtered through 3 mm. Al.

In addition to the Actinomycosis bovis, which is the most frequent cause of human actinomycosis, there are other closely related streptothrices which produce cutaneous and subcutaneous lesions similar to those encountered in this disease. In this connection there may be mentioned cases classified as nocardiosis cutis. In some cases of actinomycosis the characteristic granules cannot be found in the pus and the cultures are repeatedly negative. As a result diagnosis may be impossible, so persistent study and careful evaluation of the clinical manifestations are of utmost importance in the identification of this disease.

Primary actinomycosis of the skin independent of involvement of the viscera or bones is a rare disease. Girardi, in 1910, recorded 30 cases and since that time about 30 others have been reported. In these the disease was limited closely to the skin and lasted for several years without affecting the adjoining tissues or spreading to other parts of the body. In cases primary on the skin and limited to it, the best treatment is surgical excision.

The *treatment* of the usual varieties of actinomycosis is both internal and local. Potassium iodide in large doses by mouth is extremely beneficial, and it is reported that vaccine injections have been successful.

Of outstanding importance in the local treatment is irradiation by hard *x*-rays or gamma rays, which alone are often completely curative. Tempsky cured twenty-nine patients afflicted with the cervicofacial type by *x*-ray treatment and believes this method is successful in almost 100 per cent of such cases. Many others who have had similar results are mentioned in the bibliography. A perusal of their reports and my own experience have shown that filtration through at least 3 mm. of aluminum is desirable, with from $\frac{2}{3}$ to $\frac{3}{4}$ E. D. and a repetition, if necessary, at intervals of two to three weeks. In cases which show deep and hard infiltration, it is preferable to use 0.5 mm. copper filter and 180 kv., giving a suberythema dose.

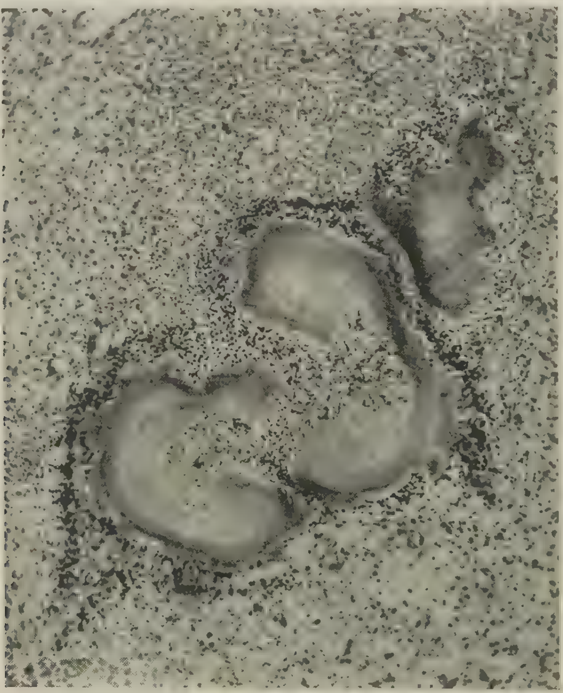

Fig. 446.—Actinomycosis of the tongue. Ray fungus in granulomatous tissue. (Courtesy of Dr. A. Benson Cannon.)

New and Figi reported one hundred and seven patients with actinomycosis of the head and neck treated by gamma radiation. They say: "Radium treatment is used in all cases and is repeated, as a rule, about once every three or four weeks. If the mass is hard and indurated, with no fluctuant areas or sinuses, radium is applied over the surface with 2 mm. of lead screening and an inch of wood distance, from 3000 to 6000 millicurie hours in this way being used. This will often break down the masses and allow them to be drained. The radium also seems to block lymphatic drainage. Since we have used this treatment, none of our patients, except in the most advanced cases with masses in the supraclavicular region, have developed extension to the chest. We have also used saturated solution of potassium iodide, starting with 10 drops three times a day, and increasing it 1 or 2 drops a dose until 200 drops three times a day are being taken. If any evidence of iodism is noticed, the iodide is discontinued for a day or two and then resumed at the same dose. After 200 drops t. i. d. have been reached, the patient discontinues the treatment for a few days or a week, and then starts in again at 10 drops. By this method we have cleared up the condition in practically all of our cases except the advanced ones, in which, on account of the proximity to the skull or the chest, the infection has extended to the meninges or the thorax." Heyerdahl has reported twenty-one patients treated by gamma rays, cross-firing from within the mouth and from an external source, "The result of the radium treatment has in all cases been cure without relapse; in the majority of cases with fine cosmetic results." He used only radium, avoiding all topical and internal remedies.

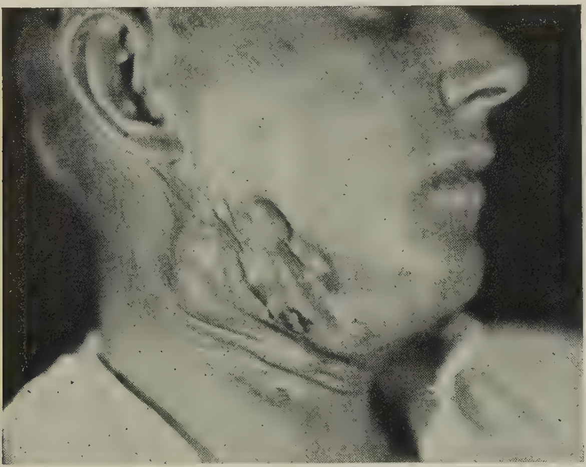

Fig. 447.—Actinomycosis. (Courtesy of Drs. J. B. and Bedford Shelmire.)

A combination of both internal treatment, local irradiation, and asepsis gives the most favorable results. Infected teeth or bone should be removed or treated, abscesses should be drained and dressed, and in small lesions employment of surgical excision, destruction by the cautery, and electrocoagulation are possible methods of value.

SPOROTRICHOSIS

Sporotrichosis is a chronic infectious disease caused by a spore-forming filamentous fungus, which is easily cultured on ordinary media but is difficult to find in smear preparations. The primary invasion is usually from occupational trauma, in gardeners, and laborers. The disease, as a rule, is localized in the skin and the subcutaneous cellular tissue and only exceptionally becomes disseminated. Regional lymphangitic sporotrichosis is the common type, causing a primary sore at the site of inoculation and in the course of a few days, week, or months, an ascending lymphangitis and multiple subcutaneous indolent painless granulomas, which soften and form cold abscesses and sometimes ulcers. The disseminated type causes multiple cutaneous or subcutaneous abscesses distributed on any part of the body. These are painless and also tend to soften and form cold abscesses, ulcers, or fistulae, without much damage to the general health of the patient.

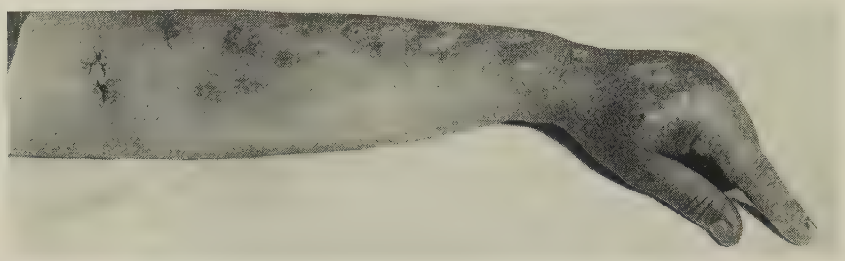

Fig. 448.—Sporotrichosis. Note subcutaneous nodules along the lymphatics draining from index finger. (Courtesy of Dr. J. Gardner Hopkins.)

Several species of sporothrix are known to exist. They commonly live as saprophytes on plants and small animals. Foerster reported 10 cases due to pricks of thorns of the barberry shrub. The disease has been experimentally produced in many laboratory animals and spontaneous cases have been observed in horses, mules, and dogs.

Human inoculation occurs accidentally at the site of some insignificant wound. The earliest manifestation may be a small nodule or ulcer, which may heal and disappear before the advent of further symptoms. In the course of a few weeks nodules generally develop along the draining lymphatics. These lesions are at first small, dusky-red, painful, and firm infiltrations. In time the overlying skin becomes adherent to them and may ulcerate, and may even show fistulous tracts or papillomatous vegetations. Sometimes the lesions heal spontaneously, but more often they progress slowly and persist indefinitely. The bones and other parts of the body may become involved.

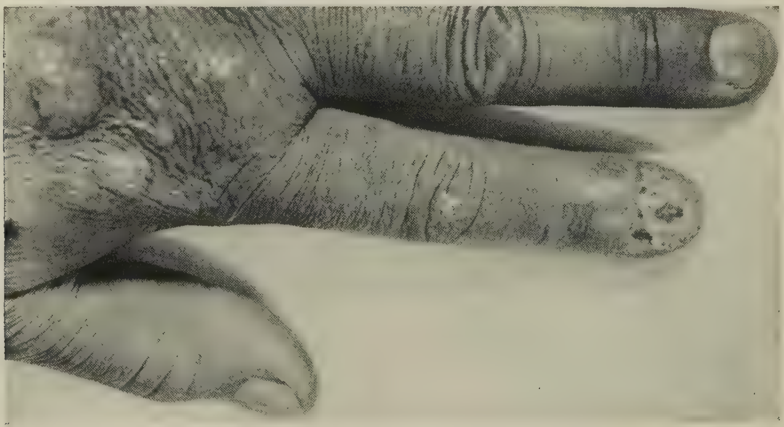

Fig. 449.—Detail of lesion at tip of index finger.

The diagnosis is established by the history of the onset, by the indolent character, the linear distribution of the nodules, and by the cultural demonstration of the sporothrix. Tuberculosis, blastomycosis, syphilis, and streptococcic infection may resemble sporotrichosis, but are usually differentiated from it without difficulty by these and other features.

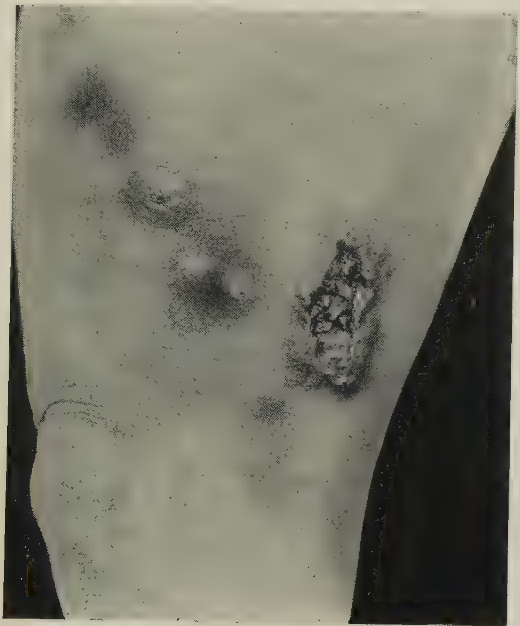

Fig. 450.—Sporotrichosis. (Courtesy of Dr. Lloyd W. Ketron.)

Internal treatment generally results in prompt involution of the lesions. Potassium iodide in doses of 30 to 90 grains daily is generally prescribed and should be continued for one month after apparent recovery to prevent recurrences. The local areas may be dressed with iodine ointment, open lesions being swabbed with tincture of iodine. Internal remedies are so satisfactory that irradiation has found little use in the treatment of the disease. Attili has reported a case in which the patient was treated by roentgen rays, and Foerster and Lain mention their use, but in both instances other treatment

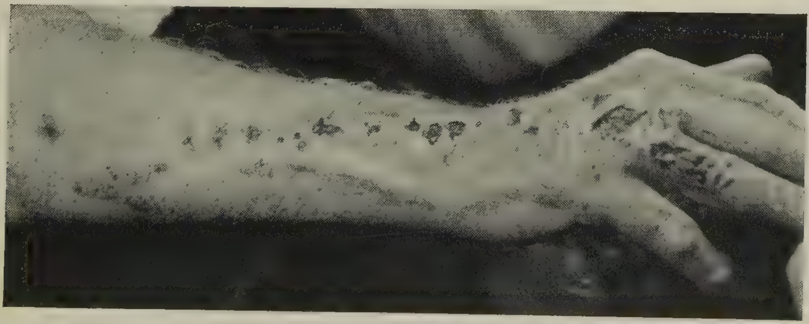

Fig. 451.—Sporotrichosis. (Courtesy of Drs. J. B. and Bedford Shelmire.)

was also given, so the results from *x*-rays alone are difficult to estimate. MacKee has stated that both Shelmire and Crutchfield have successfully treated sporotrichosis with roentgen rays without the use of iodide of potassium or other remedies.

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CHAPTER XXIII

TUBERCULOSIS CUTIS

The term "tuberculosis cutis" is used broadly for all skin diseases known to be caused by the tubercle bacillus, whereas the term "tuberculide" is applied to a group of dermatoses whose relationship to tuberculosis is doubtful and is based upon indirect evidence, such as their frequent association with tuberculosis elsewhere, their histologic structure, or their reaction to tuberculin.

The effect of infection of the skin by the tubercle bacillus varies enormously in different patients, due in part to differences in the virulence and route of the infection but, apparently, more to the resistance of the individual and his specific reaction to the bacillus and its products. The types of lesions produced are so varied in their appearance, clinical course, and response to treatment that they are considered distinct entities. In fact, they have little in common except their etiology.

This separation of various forms of cutaneous tuberculosis is useful, but at times confusing on account of the number of ill-defined types to which names have been given. Probably the most practical classification is that of Lewandowsky, which is approximately followed in this work.

(*A*) LOCALIZED FORMS OF SKIN TUBERCULOSIS

1. Lupus Vulgaris (Tuberculosis Luposa)

This is the most common type of cutaneous tuberculosis and is characterized by reddish-brown patches composed of nodules of apple-jelly color, which show a tendency to heal slowly in one area and progress in another. The nodules are minute, translucent, and embedded deeply and diffusely in the infiltrated cutis, forming plaques by coalescence and by the development of new lesions. The patches may be elevated or on a level with the rest of the skin, and often are covered by adherent scales. On diascopic examination[1] the distinctive yellowish, reddish-brown color of the nodules is apparent. The disease is destructive, frequently causes ulcerations and on involution leaves deforming scars. Lupus vulgaris usually begins in childhood and is most prevalent on exposed parts, especially the face. These are probably inoculated by dirty fingernails contaminated with organisms of bovine tuberculosis from barnyards or animal feces. Descriptive terms (lupus tumidus, lupus exedens, lupus hypertrophicus) are applied to clinical variations of the disease, but for the sake of simplicity only the atrophic, hypertrophic, and ulcerative forms will be distinguished, the reader being referred to special works for greater detail.

The atrophic type is a smooth flat patch, depressed or scarcely elevated above the skin, and composed of white scar tissue and apple-jelly nodules. The hypertrophic type is a warty vegetative growth, often crusted or slightly exudative. It generally occurs on moist areas near the body orifices. The ulcerative type may be associated with either of the foregoing, with scrofuloderma or underlying tuberculous infection of the lymph glands, bones, or other structures. Clinically, the ulcerations tend to be ragged, dirty, deep and indolent, with poor vascularity, and occasionally with pronounced tenderness, pus formation, vegetations, and crusting.

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[1] A diascope is a glass plate pressed against the skin for observing the anatomical changes other than those of congestion.

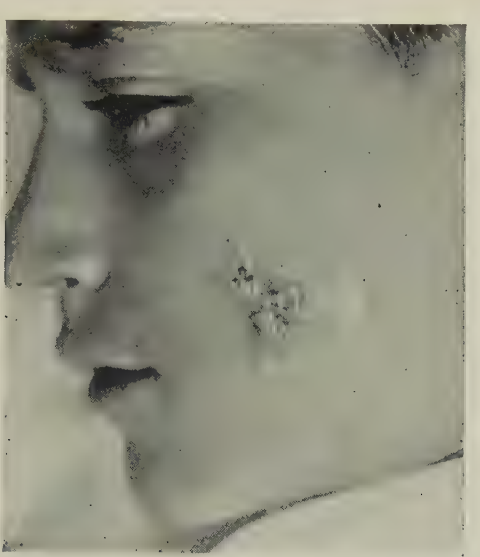

Fig. 452.—Early lesion of lupus vulgaris in a child. Scarring has already been produced. (Courtesy of Dr. Winston Rutledge.)

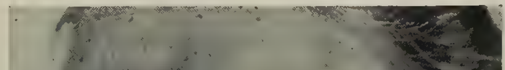

Fig. 453.—Lupus vulgaris.

At times in any type there may be profuse edema, hypertrophy, or an associated lymphangitis or lymphadenitis. Patches on the face tend to involve the nose and the lobes of the ears, and after involution of the lesions these structures are shrunken and scarred, as if nibbled away. The tip of the nose may be sharply pointed and beaklike, or the whole nose may be destroyed and only the orifices and the posterior parts of the septum and turbinates may be visible. The upper lip is a site of predilection and it becomes diffusely swollen and thickened. with fissures, adherent thin crusts, ulcers, or granulations on the mucous aspect, and a tendency to bleed. On the trunk and extremities patches of the disease may be serpiginous, or form gyrate patterns, and on the hands and feet and about the genitals may cause mutilation due to destruction, scar formation, warty thickenings, and elephantiasic enlarge-

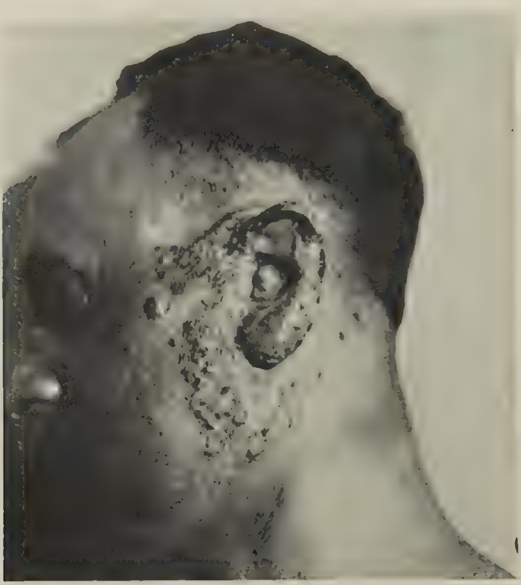

Fig. 454.—Lupus vulgaris. Note hypertrophy of ear.

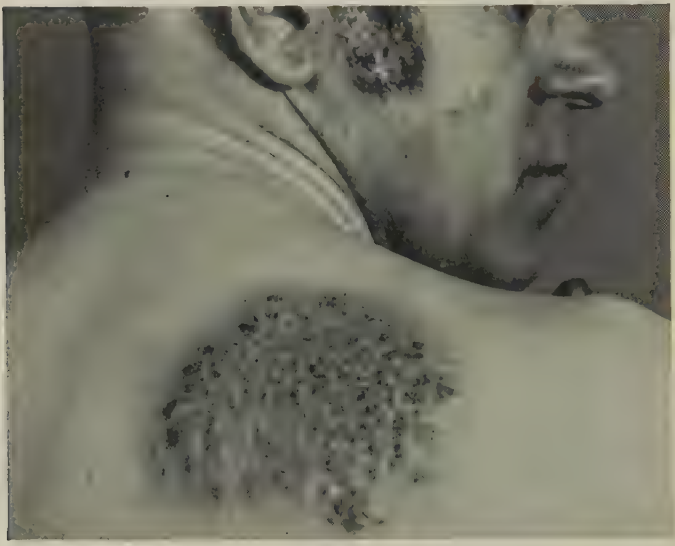

Fig. 455.—Lupus vulgaris. The individual nodules may be discerned.

ment. When the mucous membranes are attacked, the patches rapidly become papillomatous or ulcerative due to the moisture and contamination with other micro-organisms, and appear as circumscribed, grayish, macerated or granulating patches, or on the tongue as irregular, deep painful fissures sometimes associated with great enlargement of the organ so that nutrition cannot be maintained.

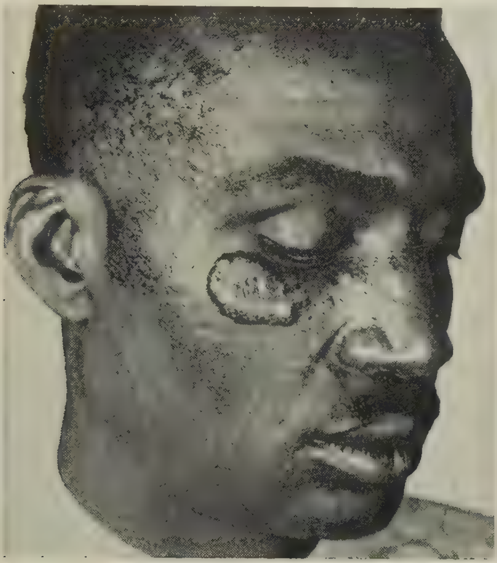

Fig. 456.—Lupus tumidus.

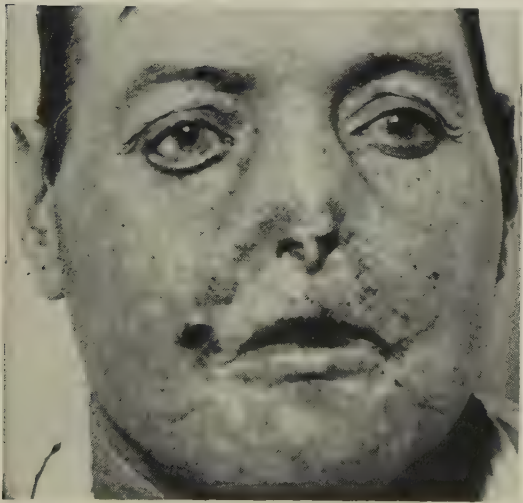

Fig. 457.—Typical beaklike deformity of the nose in lupus vulgaris. Note epithelioma developing on right cheek. (Courtesy of Dr. Edward A. Oliver.)

A variety of lupus vulgaris described by Leloir under the term "lupus vulgaris erythematoides" has a strong resemblance clinically to lupus erythematosus. It occurs chiefly on the face as discrete, erythematous, atrophic patches with raised scaling borders in which yellowish nodules become apparent on diascopic pressure.

Diagnosis.—Lupus vulgaris must be differentiated from tertiary syphilis, lupus erythematosus, mycosis fungoides, and basal-cell epithelioma. Each of these diseases has a characteristic histology which may be used to confirm the clinical diagnosis. As has been stated, lupus usually begins in childhood and evolutes slowly. One or more brownish red patches composed of apple-jelly nodules are formed, and there are more or less scaling, ulceration, and scar formation. Active nodules appear within the scar tissue. The tertiary syphilide usually occurs between the ages of twenty-five and fifty, and has a duration of less than two years. The lesions are grouped in configurate patches which tend to clear in the center while spreading at the periphery. The constituent nodules are in all stages of evolution and involution, so that in any one patch there are likely to be actively growing nodules, as well as ulcerations and scars. There are a syphilitic history and a positive Wassermann test. In mycosis fungoides the onset is during adult life and there are generally multiple infiltrated plaques accompanied by severe itching and sometimes by tumors. In lupus erythematosus the onset is during early adult life, and the course of the disease is usually not as slow as in lupus vulgaris. There are discoid erythematous patches with adherent scales, and follicular plugs which, when removed, leave gaping follicles. There is an atrophic, smooth, pliable, white scarring, but no ulceration. Basal-cell epithelioma is a disease of old age and is, as a rule, a single lesion which has a pearly, rolled border, and is definitely infiltrated, and prone to ulceration and bleeding.

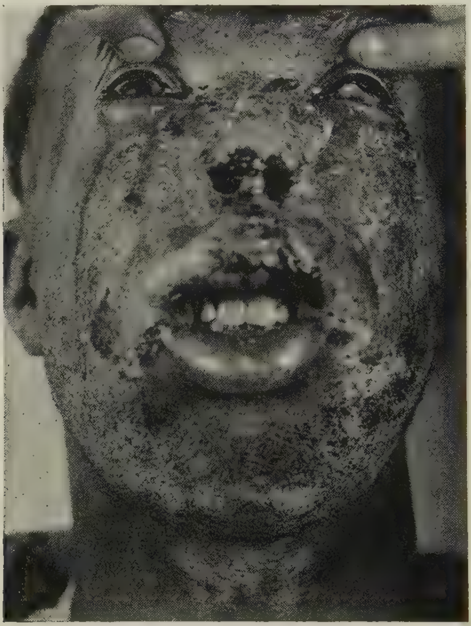

Fig. 458.—Ulceration and deformity produced by lupus vulgaris. (Courtesy of Dr. Mihran B. Parounagian.)

Treatment.—Although a certain number of cures are attained by radium and roentgen therapy in all types of the disease, the treatment of choice is thorough destruction of the diseased patch by surgical diathermy or curettage and caustic, followed by ultraviolet light. In the author's experience this combination has been the most effectual and rapid method and has entailed the least scarring. It also avoids the late sequelae of radiation therapy, which are unduly prevalent—ulcerative radiodermatitis and lupus carcinoma.

Ultraviolet Therapy.—The therapy of lupus by ultraviolet light is of outstanding importance in the realm of physiotherapy, and "for extensive cases no other method even distantly approaches it in efficiency." The disease is treated by ultraviolet radiation in three ways: (1) The carbon arc lamp concentrated locally; (2) the mercury arc lamp applied locally, and (3) a combination of either of these local treatments with general light baths. Reyn, Sequeira, and others of large experience find that the combination of general with local treatment increases the percentage of cures from 60 to 90 per cent. General irradiation alone without exposure of the diseased area will cure a notable percentage of cases.

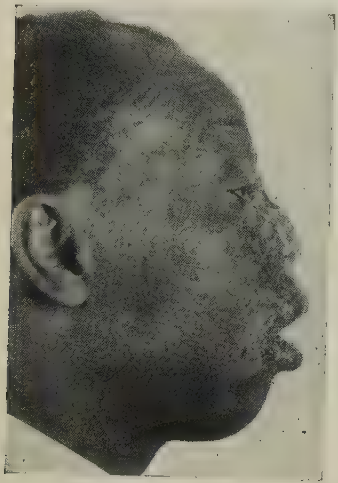

Fig. 459.—Shrunken deformity of the nose typical of lupus vulgaris. (Courtesy of Dr. Mihran B. Parounagian.)

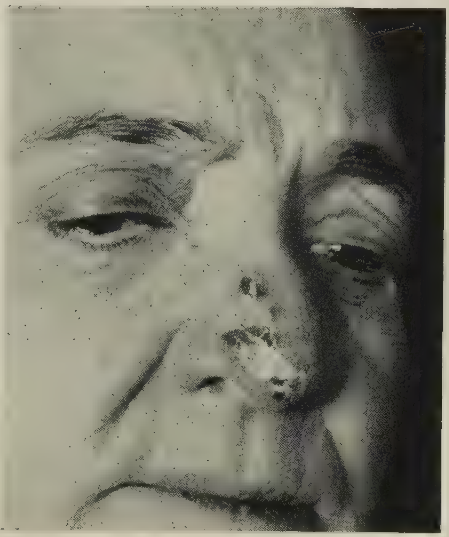

Fig. 460.—Lupus vulgaris resembling tertiary syphilis.

Whereas there have been discussions for a long time between the advocates of the carbon arc and the mercury arc methods for light baths, it is generally believed that the method fostered at first by Finsen and later by his successor, Reyn, is superior. The principal advantage of the carbon arc lamp is that its radiation (see page 211) approaches more nearly that of the solar spectrum.

It is generally accepted that patients whose skins pigment best make the most satisfactory and rapid recoveries. Mayer has suggested that the pigment may possibly sensitize the skin to the light as chlorophyl does the plant. Occasionally benefit is derived from this method in patients who do not pigment, but it is questionable whether this class of patients, especially the Titian blondes, should not be treated by other means. Recent cases involute in shorter periods than long-standing ones, and children naturally respond to treatment more quickly than adults.

Treatment should consist of general light baths and local applications of light to the diseased areas. Light baths should be given daily, preferably in the moving air outdoors. Chilling, however, should be avoided even at the expense of losing the air-movement. The technic has been described on page 223. In private practice it is often advisable to install an apparatus at the patient's home so that treatments may be given regularly each day, the patient being observed at weekly intervals and instructed concerning changes in the dosage. The light baths are continued until the lesion has healed and remained well for five or six months. It is a safe rule to underdose rather than overdose at each exposure, for excessive dosage may provoke a focal reaction similar to that caused by tuberculin, but the course of treatment should be unduly extended rather than curtailed, for many recurrences are due to premature discharge.

Direct phototherapy of the diseased area is carried on in conjunction with the light baths, but by a very different technic. The healthy parts are shielded, and the affected patch or patches and a wide zone beyond them are exposed to a dose which, instead of being mild, must be sufficient to produce an intense local inflammatory reaction (thirty to fifty minutes). A few hours after exposure to such a dose of ultraviolet light the local area becomes erythematous and swollen, and soon vesication is apparent. The superficially situated tubercle bacilli[1] are probably destroyed by the light, but most of the organisms are so deeply situated that they are not reached by the short wavelengths. Healing of the reaction occurs in five to ten days and is followed by pigmentation. The frequency of the exposures depends somewhat upon the extent of the involvement, but it is a general rule not to repeat the treatment until the reaction has subsided. The improvement results rather from the inflammatory reaction produced by the radiation than from a direct bactericidal effect.

Marked ulceration or hypertrophic scarring influences the prognosis unfavorably. Failures result most often where nodules occur in cicatricial tissue, especially that devitalized by previous roentgen radiation. The scar tissue covering the deeper portion of the nodules reduces the penetrating power of the light. Heiberg and Lomholt, in 35 out of 43 biopsies in relapsed cases, found the lowest part of the nodules at least 1.5 mm. below the skin surface, whereas the reactions to the light do not extend beyond 0.7 to 1 mm. below the skin surface.

Surgical Diathermy.—This method is widely employed for the destruction of deep-seated nodules, but I have found that its use in all cases, prior to ultraviolet therapy, expedites the recovery and decreases the percentage of relapses. The local area is painted with tincture of iodine and anesthetized by injections of novocaine well outside and below the visible disease. It is a mistake to use the desiccating current, which has only a superficial effect. The coagulation method is most effectively employed on small patches, being applied with a needle or disk electrode. When the involved areas are larger or accompanied by ulceration or hypertrophic scarring, the cutting current is more suitable. With a needle electrode the patch and a wide margin about it are separated from the healthy skin by cutting around it, extending through the full thickness of the skin down into the fat or to the fascia. The edge of the flap is then lifted and freed from the underlying tissues by lateral cutting with the same electrode. Repair is complete in three to six weeks, epithelization occurring from the edges. It is hastened by small local doses of ultraviolet light, which should not be too large for they may have a deleterious effect on the delicate epithelial cells. After healing has occurred the dosage may be increased, so that vesiculation is produced. Such local treatment should be continued for six months or more. Immediate institution of generalized ultraviolet therapy is also desirable.

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[1] Haxthausen has noticed that tissue of a lupus nodule is more transparent than normal skin to the chemically active rays. This allows the passage of from two to six times as much of these rays into the depths as are able to pass through normal skin. Optic Conditions in Lupus Nodules and Their Importance in Outlook for Finsen Light Treatment, Hospitalstidende, 67: 597–603, Sept. 17, 1924; Ab. J. A. M. A., 83: 2056, Dec. 20, 1924.

Radiotherapy.—In practically all instances roentgen and radium therapy causes improvement in the hypertrophic and ulcerative forms, but the atrophic type is exceedingly recalcitrant to these agents. In isolated cases complete cures may be established by roentgen radiation, but on the whole the results have been inferior to those obtained by the combination of local surgical or electrothermic removal with ultraviolet therapy.

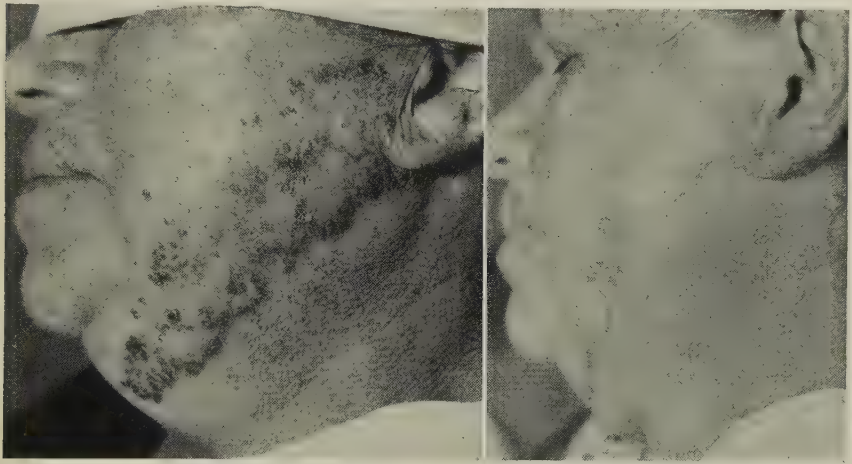

Fig. 461. Fig. 462.

Figs. 461, 462.—Lupus vulgaris. Before and after treatment by surgical diathermy, the cutting current being used.

A critical evaluation of *roentgen rays* in the treatment of lupus vulgaris is presented by Bommer. During three years a total of 112 patients who had received some form of roentgen therapy for lupus vulgaris were observed. "The treatments had been administered in a large number of hospitals and by private physicians.

"An analysis of these cases shows one cured but exhibiting bad roentgen scars; 4 cases with cured irradiated foci, and distinct roentgen effects; 8 cases showed freedom of recurrence only in the center of the scar, while 99 cases were not cured and showed recurrences even in the scar tissue. The cosmetic result was unsatisfactory or bad in most of the cases. Many of these patients showed sequelae such as ulcerations, atrophy of the mucosa of the mouth or nose, and general atrophic changes.

"These patients had received in addition to roentgen radiation, various other forms of auxiliary treatment such as radium, ultraviolet rays, and salves. It would seem that the injurious effects in the above cases were due to error in technic and dosage, although there is no information available in general as to the total dose received. It is believed that the reason for these undesirable after-effects is the uncertainty as to the maximum permissible dose." Ravogli has never obtained any good results from the application of roentgen rays in lupus vulgaris, and Stokes condemns their use in this disease. As pointed out by Sequeira, there are essentially two very distinct types of lupus—one in which there is ulceration and the other in which the lesions are dry throughout. In the ulcerative form, and in the closely allied condition, scrofuloderma, the *x*-rays may be of great service, a few applications producing rapid improvement. However, after the ulcers have healed, it is common to find isolated dry nodules in the cicatrix, and these must be treated like dry lupus, not by *x*-rays, but by ultraviolet light. He says that *x*-ray treatment must be pushed to the point of an actual dermatitis for the benefit of the dry type of lupus, and calls attention to the increase in lupus cancer after such therapy. Haxthausen holds antecedent roentgen ray treatment responsible for his failures to cure the greater number of cases of lupus refractory to Finsen therapy augmented by universal carbon-arc light baths.

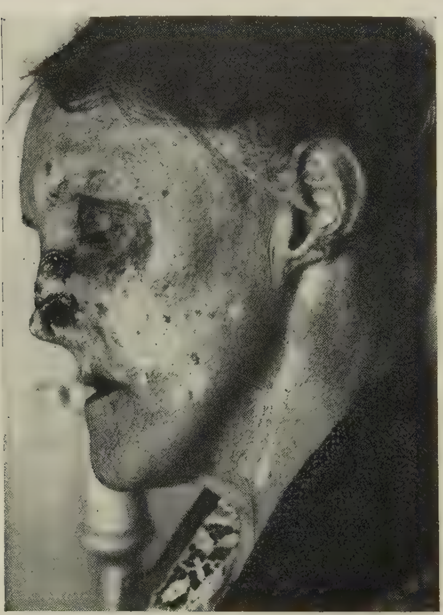

Fig. 463.—Scarring of cheek, epithelioma at the root of the nose, and typical deformity of that organ in lupus vulgaris. (Courtesy of Dr. A. Benson Cannon.)

The author has experimented with various kinds of technic for the roentgen therapy of lupus vulgaris, and has found repeated intensive dosage necessary to obtain the best results. Erythema exposures are given at intervals of four to eight weeks, being repeated as soon as the erythema of the preceding exposure has subsided. Filtration is advisable in the majority of cases. With filtered radiation the exposure time is approximately eight minutes with a 9-inch spark gap (135 kv.), 5 ma. at 10-inch anode-skin distance through 3 mm. of aluminum. With unfiltered technic the dose should be $\frac{3}{4}$ to $1\frac{1}{2}$ E. D., usually $1\frac{1}{4}$ E. D. The dose varies with the location of the patch and the age of the patient; 50 per cent of the adult dose being used for children.

Radium therapy is open to the same objections as roentgen therapy, although good results are obtained by it in a few selected cases. Small lesions of the hypertrophic and ulcerative types and rarer forms known as lupus vulgaris exfoliativus and lupus vulgaris disseminatus faciei are most amenable to this method, although in the atrophic type caustic exposures of unfiltered radiation have a value worth noting.

Whereas some workers use mostly beta-radiation to produce an inflammatory reaction and bactericidal effect, the author has observed that in all hypertrophic, crusted, thickened or ulcerated lesions recurrences are less frequent after treatment by more penetrating radiation. The use of soft radiation should be limited to superficial atrophic patches and to lesions of the mucous membrane. Both methods will be described.

The technic of treatment by soft radiation is best accomplished by radon contained in a capillary glass tube or bulb applied directly to the surface of the lesion in doses of 500 millicurie minutes per square centimeter. This exposure produces an intense superficial reaction, which heals after six to eight weeks by the formation of a smooth pliable white scar. During the period of inflammation the area should be dressed with 10 per cent boric ointment. A treatment should be repeated after the reaction has subsided if there is still any evidence of the disease. It is particularly important to care for the edges of the patch adequately. Novák has reported 400 cases treated by similar technic, of which 20 per cent were judged completely cured and 75 per cent were in good condition but still under observation with an occasional treatment. Better results were obtained when general treatment was given in addition to the local radium therapy. Quick has used soft radiation successfully and advises placing the bare emanation tubes at one end of a flat wooden spatula 5 mm. thick. This thickness lends distance to the application, and the spatula affords a handle by means of which the application may be safely held against the lesion. This increased distance gives a more even distribution of the radiation over the lesion. With this technic he uses a dosage of 10 to 16 millicurie hours per square centimeter.

Flat glazed surface applicators are also suited for this work, and may be applied unscreened to small patches. When employed in contact with the skin the dose should be between 300 and 500 millicurie minutes per square centimeter (half-strength flat salt applicator, two to three hours).

As previously stated, I have seen fewer recurrences after treatment by more penetrating radiation. The desired depth effects may be attained by filtration through 0.2 to 0.5 mm. of lead or silver. Pinch has obtained good results with similar filtration and advises an exposure of two to three hours with a full-strength plaque. My work has been done with somewhat smaller doses, namely, three to four and a half hours with a half-strength plaque of 4 sq. cm. surface area and a filtration of 0.5 mm. lead. Silver tubes may be employed as substitutes for the flat applicators, being embedded in dental modeling compound; and these are sometimes preferable in the treatment of small lesions. When the lesion is less than a square centimeter in surface area, one tube is used with a dose of 70 mg. hours, but in larger lesions the dose per square centimeter should be reduced to 50 or 60 mg. hours because of the overlapping of the radiation from the individual tubes.

Radium therapy is specially useful in cases of lupus vulgaris of the mucous membranes. The technic is similar to that described for cutaneous lupus, preference being given to unfiltered radiation in the same doses. If the area involved be a small one and the bony tissues of the palate are not affected, exposures of two hours' duration with a "half-strength" applicator, unscreened, will frequently cause disappearance of the lesion, which becomes replaced by a whitish fibrous scar. The reaction attendant upon this method of treatment is usually a sharp one, and on this account it is unwise to treat too large a surface at one time, and if a wide area of the palate be affected it should be divided into sections, which should be treated in rotation at intervals of about a month. Recurrent nodules embedded in scar tissue, or lesions affecting the ear or nose are preferably handled by other methods.

The majority of the recurrences after roentgen or radium therapy have been due to a lack of understanding of the pathology of the disease. The deep location of the nodules necessitates an intensive dose at the depth of at least a centimeter, and this is effected only by the use of filtration. When required, the exposures of both flat applicators and tubes should be repeated after the erythema from the preceding radium treatment has subsided, which is usually a matter of six weeks. However, radium therapy should not be persisted in if not promptly effective as it is likely to provoke ulcerations which may be difficult to heal.

As better results have been obtained by light treatment, many other therapeutic procedures have been discarded. They are, nevertheless, occasionally even now of value and deserve consideration. *Surgical excision* is adapted to small isolated patches preferably situated on covered parts of the body. This method is less suitable when the lupus is on or near mucous membranes, in which location it is difficult to prevent residues. It should be used only on beginning patches or nodules when there is a prospect of complete removal of the site of infection at one time and with satisfactory scar formation. Removal of the lesion by a sufficient margin (about 1 cm.) is necessary to prevent recurrences, and the dissection should be carried down through the subcutaneous tissue. Primary union is rarely possible. The flap technic is generally used, flaps being either pedunculated or unpedunculated, and large enough to allow for retraction. The surface is secured by knotted stitches and the part is securely bandaged. The first change of dressing is made after five to eight days, and the cutting of the stem in eight to ten days. *Curettage* followed by cauterization either with the Paquelin cautery or chemicals, such as acid nitrate of mercury, lactic acid, trichloracetic acid, pyrogallic acid, resorcin, iodine, or zinc chloride, may be used in hypertrophic or ulcerative lupus. Treatment by cataphoresis has been occasionally successful, but it is uncertain and very painful. *Refrigeration* (see page 632) by solid carbon dioxide produces an intense reaction which is followed by a pliable scar. The cosmetic results are generally good. Repeated treatments are necessary to invoke a cure. The pain caused by the freezing is considerable. *Tuberculin injections* (page 630) have been extensively employed and have many adherents. I have seen such dreadful results from overdosage in the hands of experts that I have given up this method. The intravenous use of *gold preparations* (page 630) sometimes exerts a favorable influence in this disease. These last three methods are described in more detail under the treatment of lupus erythematosus, and the reader is referred to the bibliography for further information. In proportion to their importance, adequate mention has not been made of the light baths at the large foreign lupus clinics, for they are not practicable in this country because of the scarcity of the disease.

Systemic Treatment.—In all cases of lupus it is desirable to invoke measures to improve the general health. The ultraviolet light baths already referred to are of great value, as is also the use of cod liver oil. Nutritious food, rest, outdoor life, and sunshine contribute significantly to the cure of even limited eruptions.

I am indebted to Dr. Edgar Mayer for the following notes on the nutritional therapy of lupus:

"Recent studies from Sauerbruch's surgical clinic in Munich and from Jesionek's dermatological clinic in Giessen urge the curative value of a base-forming *diet* low in sodium chloride, protein, and carbohydrate and rich in fats and vitamins. This régime was devised empirically by Gerson.

"I was privileged, under the auspices of Mr. August Heckscher, to visit these German clinics. Definite healing was observed in advanced cases of lupus vulgaris of the face and mucous membranes that had previously been resistant to all other forms of accepted treatment. These results were far more striking than those claimed for the other forms of tuberculosis. Within a few days after the beginning of the treatment a retrogression of the swelling and a change in the color in the vicinity of the lupus nodules were often noticed. After the swelling and the bluish-red discoloration have disappeared, a narrow bright-red margin remains, which gradually fades away during the following weeks. The various lupus infiltrations in the now entirely blanched skin become at first more distinct, but then seem to melt away; they spread out in all directions, the margin becoming less well defined, until they are gradually absorbed by the surrounding tissues and disappear. There remains only a bright-red network, made up of minute whitish scars, until gradually the redness disappears and a delicate pale scar is left, which is with difficulty distinguishable from the surrounding skin. The time within which a cure is effected varies considerably. The duration of the treatment can be shortened by the combined use of previously recognized modes of treatment. General light treatment and particularly sun baths (of the whole body) exert a favorable influence. It is possible to effect a complete cure in grave, extensive, and resistant cases. The cure is accomplished with most excellent cosmetic results.

"The German clinicians advancing this dietary appear to be confused as to its acid- or base-forming value. An analysis of the diet reveals definitely to us its base-forming nature. Attempts to increase the mineral intake have favored the addition of inorganic compounds under the trade name of 'Mineralogen,' 70 per cent of which is calcium phosphate and lactate. One of the outstanding features of the diet is its rich source of vitamins A to G. Much consists of raw food and that which is cooked is abundant in vitamins.

"This study stimulated sufficient interest on our part to subject a group of patients at Saranac Lake to the diet. Thirty patients with far advanced pulmonary tuberculosis were selected who had previously received all of the accepted therapy for two or three years, but had failed to respond. Two thirds were maintained on this diet for six months. Favorable findings were attributed to the diet in about half the cases studied, but contributory factors, such as enforced rest, scrupulous preparation and careful cooking of food, individual service, and psychic factors, may have been operative in the end-result in these pulmonary cases. On the contrary, the favorable results in lupus as seen in Munich and Giessen, and even in Rollier's clinics, we attribute directly to this dietary régime.

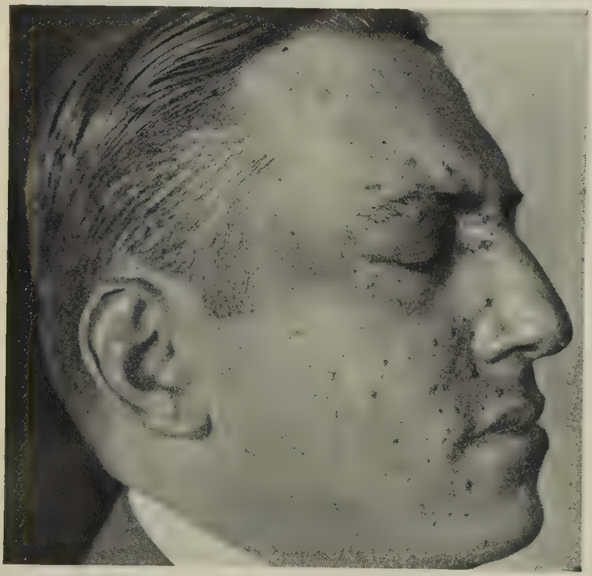

Fig. 464.—Lupus miliaris disseminatus. (Courtesy of Dr. Paul Gross.)

"We believe that the inorganic constituents whether they be acid- or base-forming are not as important as the vitamin content of the dietary. To what extent the effects obtained are to be attributed to the diminished sodium chloride or to the 'Mineralogen' factor has not yet been determined."

Two rather distinct varieties of lupus vulgaris are:

(*a*) **Lupus Miliaris Disseminatus.**—This is a mild form, appearing as multiple, minute, discrete, superficial nodules, often on the face, which tend to heal with only slight scars. The lesions may be surmounted by small crusts or pustules and are likely to appear in crops and then after a few months to involute spontaneously. The diagnosis is confirmed by the apple-jelly color apparent upon diascopy, and by microscopical study of tissue, which may reveal central caseation in addition to the usual features of lupus vulgaris. Tubercle bacilli have been demonstrated.

In addition to the systemic treatment desirable for all types of cutaneous tuberculosis, the involved local areas should be destroyed; this is best accomplished by electrical desiccation. No anesthetic is usually required. Good results are also obtained by sharp reactions to unfiltered radium or by blistering exposures of ultraviolet light on the diseased surfaces.

(*b*) **Lupus Pernio.**—This is a diffuse, purplish, edematous affection due to involvement of the blood vessels, and is commonly known as chilblain lupus. It affects the ears, nose, hands, feet, and the mucous membranes. Like chilblain, the purplish erythema may be of seasonal occurrence. Probably such eruptions are lupus erythematosus, although in some instances true lupus is present.

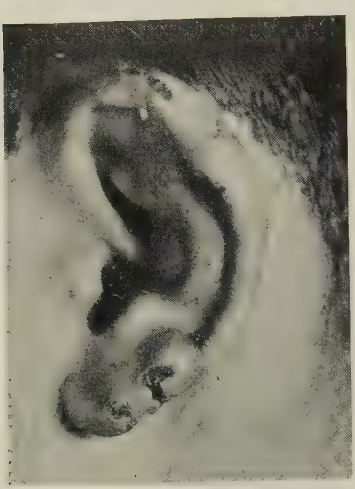
Fig. 465.—Lupus pernio. Redness, swelling, and ulceration of the ear.

The treatment will depend upon the histologic structure. Where typical tubercles are observed, erythema exposures of ultraviolet light are indicated, and when the histologic structure does not show true tuberculosis, the affection should be treated as lupus erythematosus. In the latter group of cases, although the disease is a clinical entity, the cause is still unknown. Arsenic, iodides, tuberculin injections, and carbon dioxide snow are used empirically, at times with considerable success.

2. TUBERCULOSIS VERRUCOSA CUTIS (TUBERCULOSIS VERRUCOSA)

This variety is characterized by warty vegetations, which sometimes extend to form large patches. The growths are persistent although usually superficial and limited in their extent. They may be separated by exudative or suppurative areas, but they never ulcerate and seldom heal spontaneously. The vegetations are possibly secondary to the presence of pyogenic cocci of low virulence. The disease is most common on the hands and other parts of the extremities, usually in adults and is probably the reaction of a highly resistant individual to external inoculation. The anatomical wart which results from infection arising from autopsies or the handling of tuberculous meat is the prototype of tuberculosis verrucosa cutis. Clinically, this is usually a single hyperkeratotic, dull red lesion which persists harmlessly and indefinitely with very little growth; but at times it may be accompanied by serious developments such as erysipelas, generalized tuberculosis, or gangrene.

Frequent locations for tuberculosis verrucosa cutis are on the dorsa of the fingers and the hands, ankles and the buttocks. The lesions occur as dis-

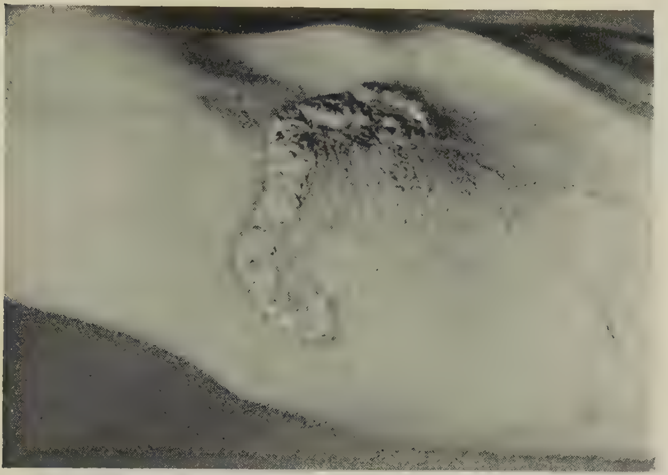

Fig. 466.—Tuberculosis verrucosa cutis, serpiginous lesion.

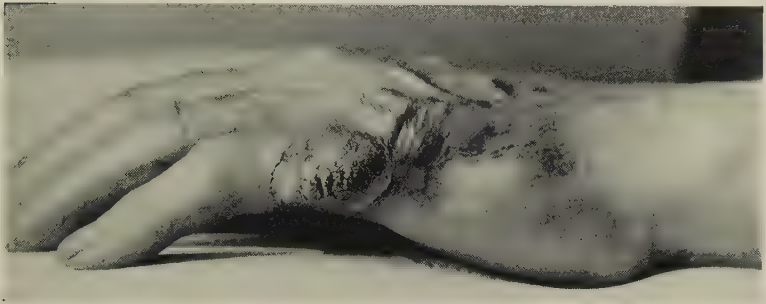

Fig. 467.—Anatomical wart.

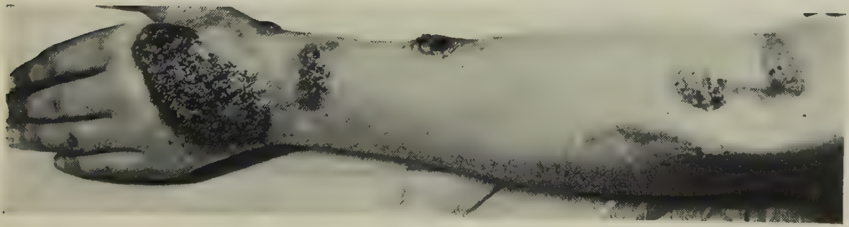

Fig. 468.

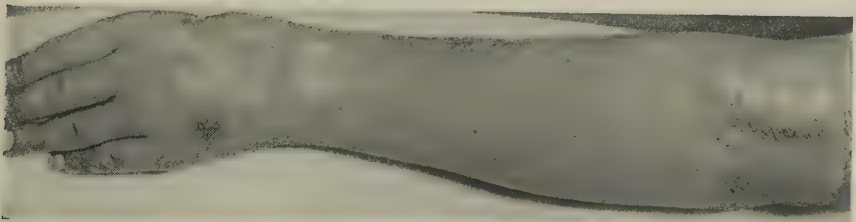

Fig. 469.

Figs. 468, 469.—Tuberculosis verrucosa cutis. Before and after treatment by surgical diathermy, coagulating current, and by ultraviolet light.

coid, circumscribed, warty patches of nummular or palm size, and sometimes are configurate. They may be single or multiple and may resemble blastomycosis, although they are generally drier and less inflammatory.

Treatment.—Superior results have been derived from *surgical diathermy* in this disease. The destruction is done under local anesthesia. The monopolar current is adapted to small lesions, which, after dehydration, are curetted down to a healthy base and allowed to granulate. The larger lesions should be handled by the coagulation current. Special care must be exercised to destroy well beyond the apparent edges. Following coagulation, the detritus is removed with a curet and a dressing of boric ointment applied. Surgical diathermy should be followed by ultraviolet therapy applied to the local lesion and to the entire body. Locally, intensive exposures of either air- or

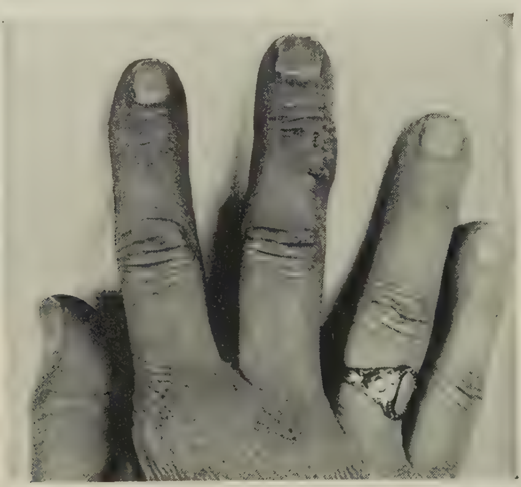

Fig. 470.

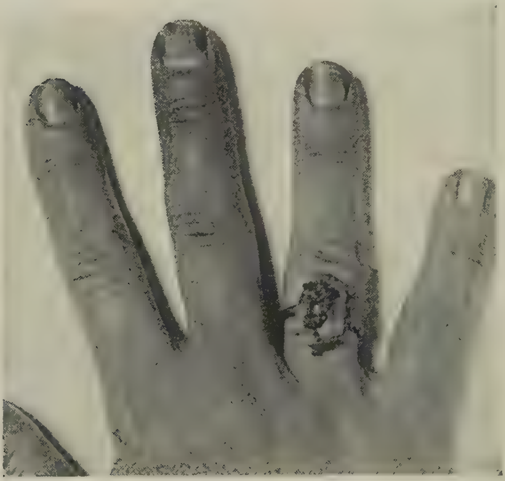

Fig. 471.

Figs. 470, 471.—Anatomical wart. Before and after $\frac{3}{4}$ E. D. of unfiltered x-rays. Usually a larger dose is necessary to obtain such a result.

water-cooled lamps should be made at weekly intervals to produce second or third degree reactions. Generalized treatments with air-cooled ultraviolet irradiation should be given daily for tonic effects.

Occasional cures are obtained by *x*-ray and radium therapy. When *roentgen rays* are employed, the dosage should be intensive, consisting of 1¼ to 2½ E. D., unfiltered, or 1 to 2 E. D., filtered. Where the nodular infiltration is deep, penetrating radiation is preferable. With 9-inch pointed spark gap, 5 ma., 10 inches distance, through 3 mm. of aluminum an exposure of eight to fourteen minutes is given. Treatment is repeated after the erythema from the preceding exposure has subsided, which is usually in about six weeks. Unfiltered *radium* in doses of 500 millicurie minutes per square centimeter gives excellent results in small lesions. Usually one treatment suffices for a cure. For larger lesions, the radiation should be filtered through 0.5 mm. of lead. Because of the convexity of most of the lesions, silver tubes embedded in dental modeling compound are preferable to flat applications, in doses of 50 to 60 milligram hours. When subsequent exposures are necessary, these may be administered after the disappearance of the reaction.

3. SCROFULODERMA (TUBERCULOSIS COLLIQUATIVA)

"Scrofuloderma" is a comprehensive term applied to involvement of the skin secondary to underlying tuberculous processes by direct extension. It occurs most frequently over the cervical lymph nodes, over bone or about joints in children and young adults. Clinically, the lesions are reddish granulations, more or less edematous, exudative, and crusted, with small sinuses or ulcerations of various sizes, with undermined edges. The process usually begins with a deep, purplish induration of the skin in overlying diseased lymphatic glands, which for months preceding usually have been matted together and doughy. The glands tend to break down and the resulting purulent and caseous exudate stretches the superimposed skin, and forms fistulous openings in it. Chronic discharging sinuses and oval or linear ulcerations, irregular pale granulations, bulky crusts, hypertrophic scars and cicatricial bands result, and these combined conditions compose scrofuloderma.

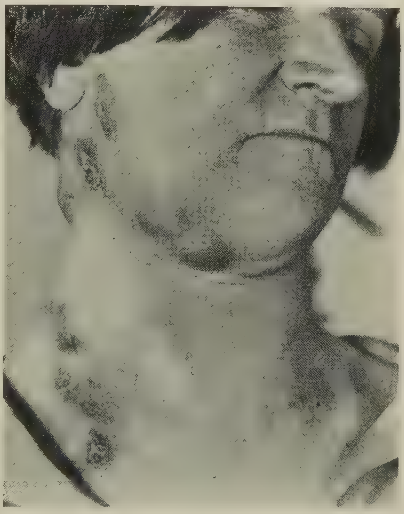

Fig. 472.—Scrofuloderma.

Isolated subcutaneous, tuberculous indurations of the skin resembling scrofuloderma are designated *scrofulous gummas.* These lesions may precede the development of scrofuloderma or occur independent of any subjacent tuberculous process, generally in persons of low vitality, particularly children. The most frequent sites for scrofulous gummas are on the extremities, where they slowly develop and break down to form indolent ulcers with undermined edges and necrotic bases, and other lesions such as are encountered in scrofuloderma.

The **treatment** is similar to that described for lupus vulgaris, except that better results follow the use of x-rays. In addition to systemic treatment, it should be the aim to cure the local tuberculous process underlying the skin affection. Surgical excision is better than any other method when the primary tuberculous disease is discrete, but when glands have become matted together or caseation or ulceration is present, radiotherapy is preferable. Roentgen treatment should be with penetrating radiation. Three fourths of an erythema exposure is given at intervals of six weeks through 3 mm. of aluminum, the operator focusing so as to include the primary internal tuberculous process, as well as the secondary skin involvement. The avoidance of an erythema usually obviates radiation sequelae. There is a tendency in scrofuloderma to severe scarring, which is often keloidal. This may be improved considerably by proper x-ray dosage.

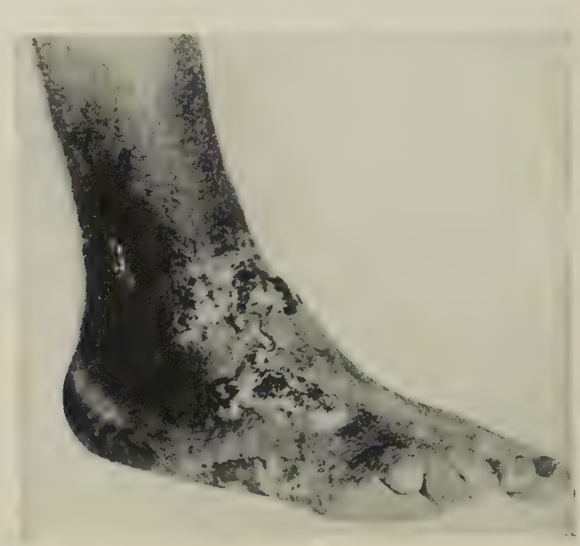

Fig. 473.

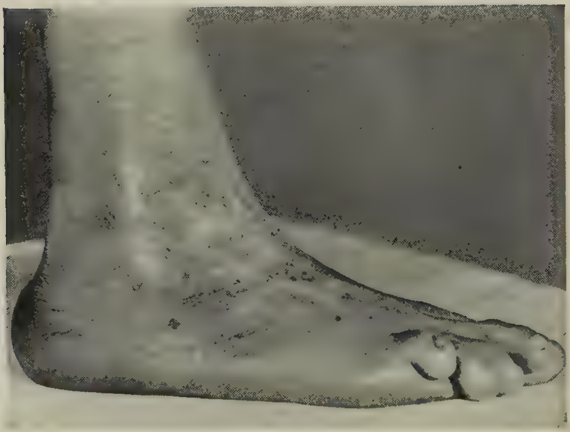

Fig. 474.

Figs. 473, 474.—Scrofuloderma. Before and after x-ray treatment—fractional doses of radiation filtered through 3 mm. Al.

Ultraviolet light treatment is of fundamental importance in this disease, as it is in other forms of cutaneous tuberculosis. Although the local lesion may often be healed by its persistent use, the principal benefit lies in its tonic action when given to the entire body surface in the form of light baths, especially if in conjunction with other systemic measures.

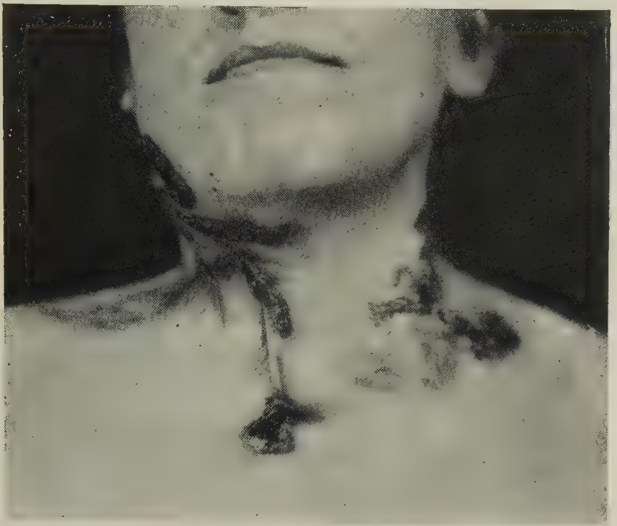

Fig. 475.—Scrofuloderma in a common location. Note typical sinuses and hypertrophic scarring. (Courtesy of Dr. Lewis B. Robinson.)

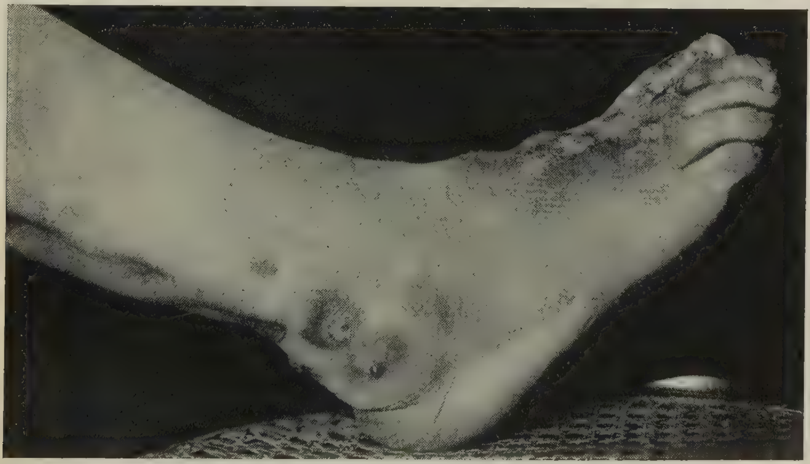

Fig. 476.—Scrofuloderma secondary to tuberculous osteomyelitis.

4. TUBERCULOSIS ULCEROSA (TUBERCULOSIS ORIFICIALIS)

This form of localized tuberculosis ulcerates from the beginning and extends rapidly with no tendency to spontaneous healing. The ulcers are usually oval, shallow and discrete, and covered by crusts. Miliary tubercles may be seen on the adjacent mucous membrane. The disease occurs most

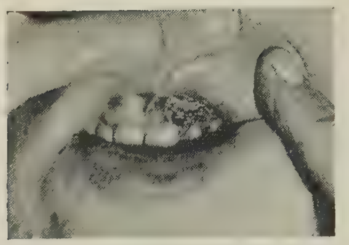

Fig. 477.—Tuberculosis ulcerosa of the gum. Patient also has pulmonary tuberculosis.

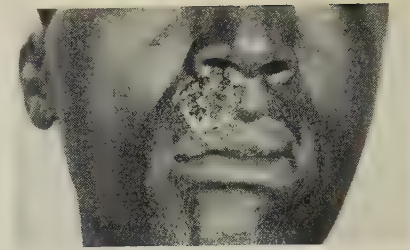

Fig. 478.—Tuberculosis orificialis associated with tuberculosis of the lungs.

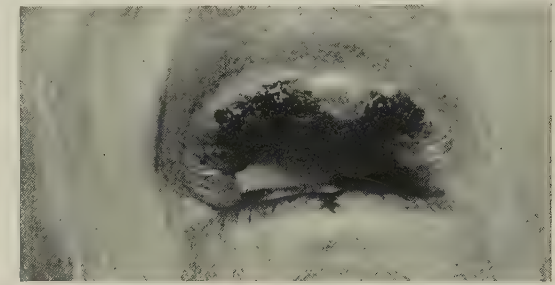

Fig. 479.—Tuberculous lymphangitis of the upper lip, associated with tuberculous ulceration of the gum and with pulmonary tuberculosis.

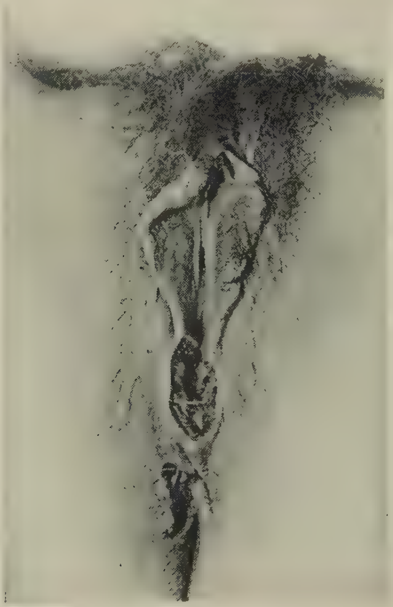

Fig. 480.—Tuberculosis ulcerosa of the perineum, associated with tuberculosis of the urinary tract.

frequently at the mucocutaneous borders of the nose, mouth, anus, and the genitalia, also on the mucous membrane of the mouth and occasionally on the outer skin. It is found usually in young adults with severe visceral tuberculosis, particularly of the larynx, palate, lungs, intestines, and genitourinary tract, and with slight resistance to the disease.

The **treatment** must be largely systemic. Very serious mistakes are made by dermatologists who fail to appreciate this fact. At the discretion of the internist, the local ulcerations may be dealt with. Radium is superior to other local remedies, the soft rays being utilized in doses sufficient to produce sharp reactions (half-strength flat salt applicator, contact, unfiltered, for two to three hours, or filtered through 0.2 mm. lead for four to five hours). In accessible locations good results also are obtained by *x*-ray treatment, with unfiltered technic and doses of 1½ to 2 E. D., shielded.

(*B*) EXANTHEMATOUS FORMS OF SKIN TUBERCULOSIS

1. Miliary Tuberculosis of the Skin

This is a rare form of tuberculosis that appears as an acute generalized eruption of indolent, brownish-red, acuminate papules which become necrotic and may form numerous minute ulcers. These are small and circular with a dull red border and a pallid granulating base covered by a seropurulent exudate. Miliary tubercles may be present in the base or at the edge of the ulcer. Tubercle bacilli have been demonstrated in these lesions. Exanthematous miliary tuberculosis usually occurs in infants following measles or scarlet fever, due to the softening of a tuberculous gland, with embolism through the blood stream, or at the outset of an attack of general miliary tuberculosis, and is fatal. Generally the patients have other unmistakable signs of tuberculosis.

2. Lichen Scrofulosorum (Tuberculosis Lichenoides)

The eruption consists of groups of indolent, minute, keratotic, follicular papules, scattered over the trunk or extremities. The lesions are pinhead sized or smaller, and the color of normal skin or reddish-brown. They are firm and flat-topped, or surmounted by a tiny pustule or thin scale. The lesions are arranged in nummular groups, usually on the trunk, where they

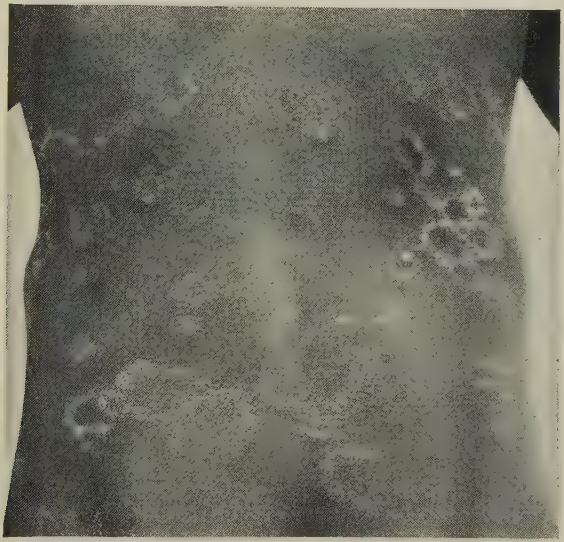

Fig. 481.—Lichen scrofulosorum. (Courtesy of Dr. Mihran B. Parounagian.)

persist unchanged for long periods and occasion no symptoms. They may slowly undergo spontaneous involution, followed at times by recurrences. As a rule, they appear in children who have tuberculosis of the bones or lymph nodes. The treatment is largely systemic, and ultraviolet light baths are used.

3. PAPULONECROTIC TUBERCULIDES (TUBERCULOSIS PAPULONECROTICA)

Varieties.—Acne scrofulosorum, papular and nodular tuberculide, acnitis, acne agminata, folliclis.

Darier has designated as tuberculides a number of apparently very dissimilar conditions supposedly caused by bacillary embolisms from lesions in the viscera. Cutaneous reactions to these products may vary greatly according to the degree and kind of allergy possessed by the individual and according to the attenuation and amount of the incident material. The lesions are bilateral and symmetrical and essentially are small indolent granulomas. The commonest type is known as papulonecrotic tuberculide. This eruption appears in successive crops, usually on the extensor surfaces of the extremities and also on the face and trunk in children and young adults who have chronic tuberculosis elsewhere. The typical lesions vary in size from a pinhead to a pea, and are firm, isolated, follicular papules or nodules, which undergo central necrosis and heal spontaneously with pitted scarring. "Acnitis" and "acne agminata" are terms applied to the type of tuberculide localized on the face, and folliclis, to a deeper type, favorite sites being on the hands, feet, forearms, and ankles. The lesions tend to be grouped, and are at first papulovesicles and later pustules or nodules. To palpation, they are firm and painless. There is a tendency for the lesions to run their course in a few months and to be followed by fresh outbreaks, the disease lasting for years. Frequently two or more of the various types are present in the same patient, or the tuberculides may appear in association with other cutaneous manifestations of tuberculosis, particularly erythema induratum, lichen scrofulosorum, or scrofuloderma.

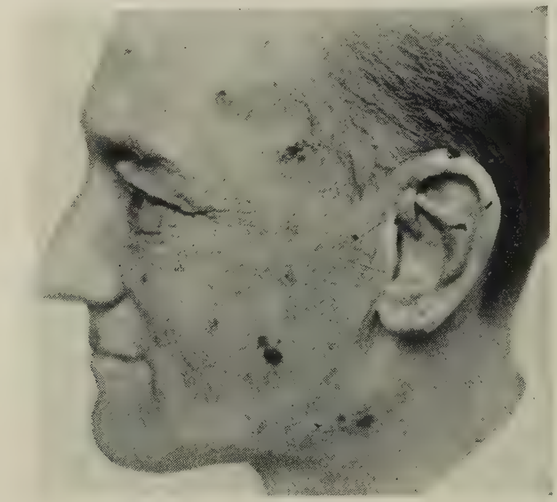

Fig. 482.—Papulonecrotic tuberculide.

The tendency is toward spontaneous cure, but systemic treatment is important to prevent recurrences. Stress must be laid upon general hygiene and nutrition. Cod liver oil and the use of heavy metals such as arsenic, gold, mercury, iodine, and bismuth are indicated; as also are tuberculin injections in small doses. Locally, irradiation is of some value. Fractional unfiltered *x*-ray treatment causes involution of the lesions in the majority of cases. Usually six or eight weekly exposures of $\frac{1}{4}$ E. D. are sufficient. Equally good results are obtained by ultraviolet therapy in erythema doses repeated every day.

Miscellaneous Tuberculides.—Various other dermatoses have been assigned a relationship to tuberculosis upon questionable grounds. Darier has attempted to clarify the disorder produced by their diverse clinical forms and suspected causes, and to his work the reader is referred. The scope of this book permits mention of only those which are common. Acne varioliformis has been ascribed to the toxins of tuberculosis, but the connection is not well established. The treatment has been given in Chapter XX.

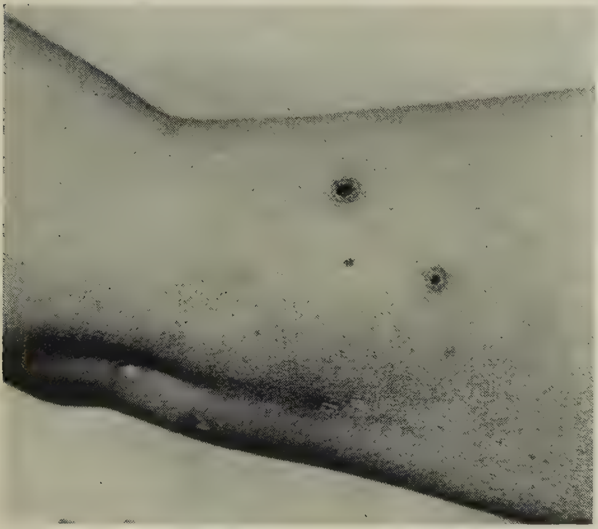

Fig. 483.—Papulonecrotic tuberculide, close-up view. Note depressed scars, as well as active lesions.

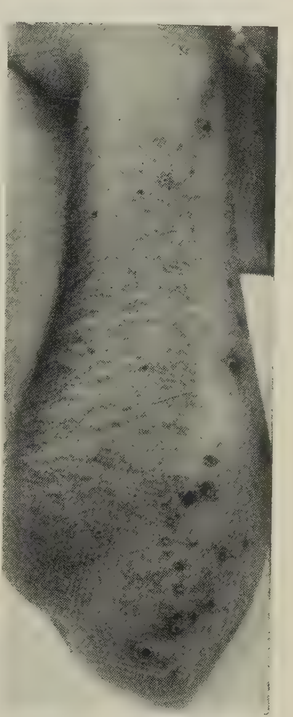

Fig. 484.—Papulonecrotic tuberculide. Note scars on elbow. Similar lesions were distributed symmetrically on the other arm and on the legs. (Courtesy of Dr. Mihran B. Parounagian.)

4. ERYTHEMA INDURATUM (BAZIN'S DISEASE, TUBERCULOSIS INDURATIVA)

Erythema induratum is a chronic benign form of tuberculosis that causes soft nodules about the subcutaneous vessels of the lower part of the leg, which may progress into deep-seated indurations, ulcerations, and scarring. The lesions are usually symmetrical and indolent, but may heal spontaneously. They occur only in young women, usually in those who have glandular tuberculosis. In the period of evolution the lesions are slightly tender erythematous indurations which gradually become deep nodules. In the course of months the overlying skin assumes a dusky or bluish color and on palpation there is noted some central softening, which frequently progresses into ulceration. The ulcers have irregular shapes and are deeply excavated, with steep or undermined edges. At times neighboring lesions coalesce. In any one case there are generally some depressed white scars from previous ulcers, as well as active lesions in all stages of evolution and involution, numbering anywhere from two or three up to a dozen or more. The lower calf is the favorite situation on the leg; rarely the disease may occur on the front of the leg, on the arms, or elsewhere. As the result of recurrences the disease may persist for years.

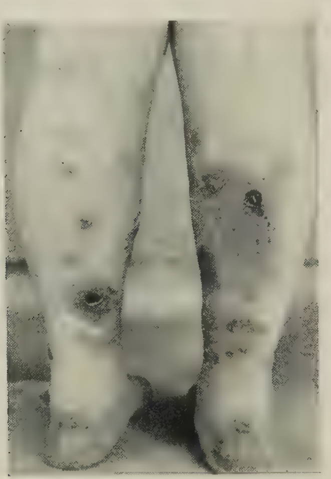

Fig. 485.

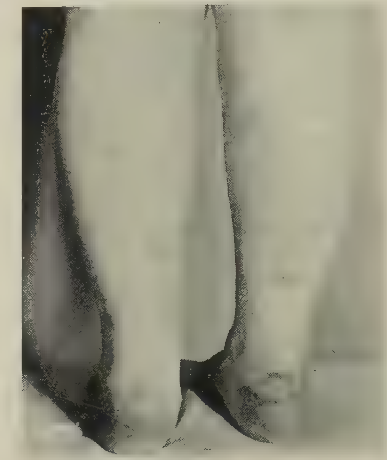

Fig. 486.

Figs. 485, 486.—Erythema induratum. Before and after treatment with gold sodium thiosulphate injections. (Courtesy of Dr. Winston Rutledge.)

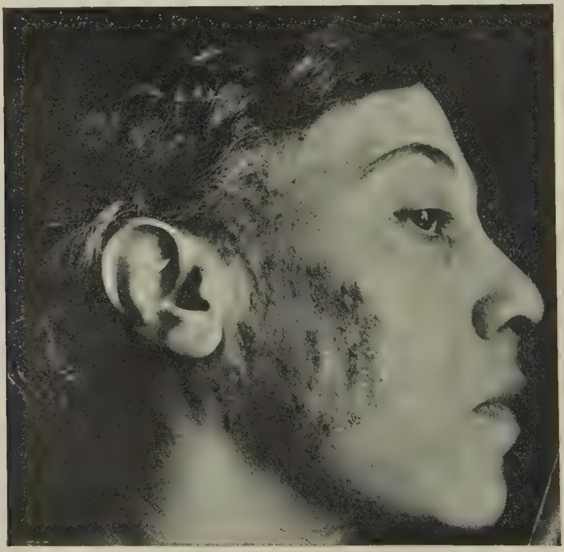

Fig. 487.—Sarcoid, Boeck type. (Courtesy of Dr. Kendal Frost.)

Care should be taken to distinguish erythema induratum from erythema nodosum, the gummatous syphilide, and from the nodose lesions caused by iodides and bromides. Erythema nodosum is of relatively short duration and of rapid development, and affects chiefly the shins instead of the calves. It produces tender, painful, scarlet nodules which appear simultaneously and do not ulcerate, whereas in erythema induratum the sensory symptoms are insignificant and the color is darker, and the lesions tend to evolve serially or in crops. Gumma is unilateral, and usually a single lesion or a small distinct group of lesions. Serological, microscopical, and therapeutic tests are decisive. The lesions due to iodides and bromides resemble erythema nodosum, or cause ulcers with vegetating bases.

Many eruptions of erythema induratum involute in the course of a few months simply as a result of tonic régime, and rest by elevating and carefully bandaging the limbs. It is difficult, however, to conduct this treatment as the average patient is ambulatory. In this type of case at any stage of the disease the best effects are obtained from gold injections and medical diathermy, the latter being applied with one electrode on the ankle and the other on the thigh, by the use of about 1200 ma. for twenty minutes daily. This leads to a local rise in temperature and congestion, favoring early absorption and healing. Radiation is only of slight value. Generalized ultraviolet light is a useful adjunct to other forms of treatment, but rarely by itself produces a cure. Intensive local applications slightly stimulate the healing of ulcerations. In early evoluting lesions, before they are broken down, erythema exposures of filtered *x*-rays or the gamma rays of radium may be abortive, but they are of little use after ulcerations have developed. Cannon, Clark, Fordyce, MacKee, and others have reported favorable results from tuberculin injections.

5. Sarcoid

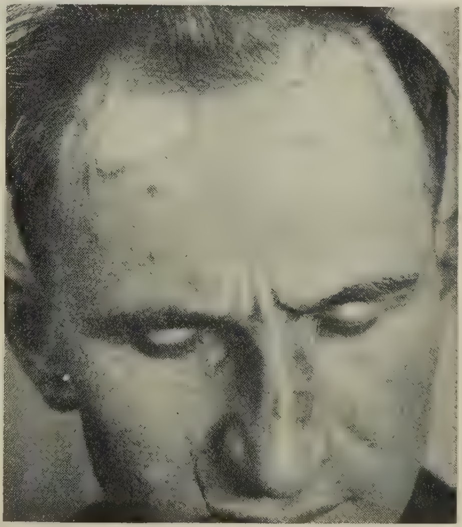

Fig. 488.—Sarcoid. (Courtesy of Dr. Hermann Feit.)

Darier, Roussey, Boeck, and others have applied the term "sarcoid" to certain nodular grouped, superficial, and subcutaneous granulomatous infiltrations which show more or less tuberculous histology. The lesions are usually multiple, firm and elastic when palpated, and are noted to extend further than inspection would lead one to believe. They affect the entire cutis, with little change in the overlying epidermis, which may, however, be thinned, telangiectatic or slightly scaly. The lesions tend to involute in the center and spread in a raised ring at the border, but eventually heal, leaving practically no trace, although at times some atrophy or scarring. The color is faint, being dull tints of red, purple, or brown, according to the stage of development. When the lesions are dehematized by pressure, yellowish points—which suggested the term "miliary lupoid"—can be discerned. The nodules and plaques never break down or produce an exudate. The sites of predilection are the face, external surfaces of the arms, and the shoulders for the superficial (Boeck) type, and the trunk for the deep (Darier-Roussey) type, although other areas may be affected and often the two types are associated in the same patient. The deep type of sarcoid may develop to a nodule, 2 or 3 cm. in diameter, and occasionally undergoes central softening and ulceration. Syphilis and leprosy may produce the same type of lesion. Other structures, as well as the skin, may be sites of the disease, either with or without associated involvement of the skin. Lesions have been described in the osseous, respiratory, digestive, and urinary systems, in the lymph nodes, tonsils, spleen, and elsewhere.

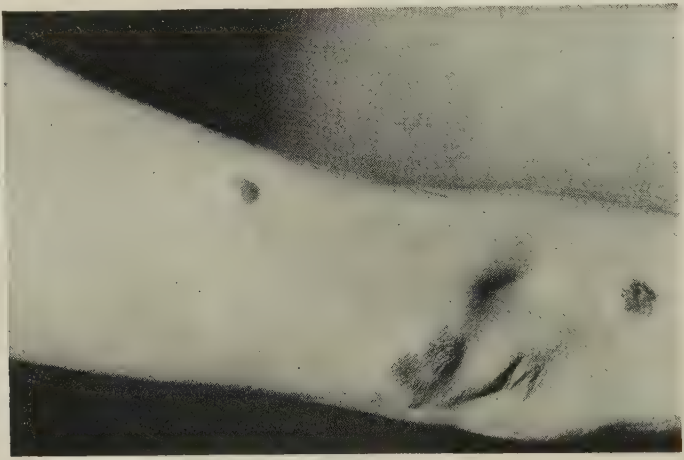

Fig. 489.—Sarcoid, Boeck type.

If the lesions are of a tuberculous nature the best results are obtained by gold injections or irradiation. When the lesions are markedly fibrotic the response is slower than when they are largely cellular. Some sarcoids respond favorably to intensive local exposures of ultraviolet light, but a larger number are benefited by *x*-ray and radium therapy. The deeper lesions are best treated by filtered *x*-rays or gamma rays, and the superficial ones with unfiltered *x*-rays or beta rays, with fairly intensive dosage, in general such as is described for small basal-cell epitheliomas. The disease may improve under internal treatment with tuberculin or arsphenamine.

6. ANGIOLUPOID

These rare lesions consist of small red oval infiltrated plaques with numerous telangiectases over the surface, and occur usually on the sides of the nose. They show no tendency to heal and are refractory to treatment.

(*C*) DISEASES OF UNCONFIRMED TUBERCULOUS ETIOLOGY

1, Lichen nitidus, page 466; 2, erythema nodosum, page 345; 3, exfoliative erythrodermia (pityriasis rubra), page 450; 4, skin lesions of Hodgkin's disease, page 954; 5, granuloma annulare, page 344.

LUPUS ERYTHEMATOSUS (LUPUS ERYTHEMATOIDES, SEBORRHEA CONGESTIVA, LUPUS NONEXEDENS, ULERYTHEMA CENTRIFUGUM, LUPUS SEBACEUS, ERYTHEMA ATROPHICANS)

Lupus erythematosus is a superficial inflammation of the skin, usually running a chronic, but sometimes an acute, course. It consists of reddish, infiltrated plaques, covered by adherent scales. The follicles of the involved areas are often patulous and filled with horny epidermal plugs, which may be seen on the undersurface of the scale when it is removed. The patches tend to spread at the border and heal at the center, with atrophy, scarring, and telangiectasis. They never ulcerate, but are extremely persistent, and refractory to treatment. There are two principal types of the disease: (1) A fixed circumscribed discoid type, and (2) a disseminate, more or less exanthematic type. The former is the more prevalent and runs a chronic course, whereas the latter is much more acute and likely to be fatal.

The lesions occur mainly in young adults, on the bridge of the nose and the flush areas of the cheeks, where the shape of the patches may suggest a butterfly. Frequently the ears and the backs of the hands are also involved, and the disease may affect the mucous membranes, the scalp, or the glabrous skin.

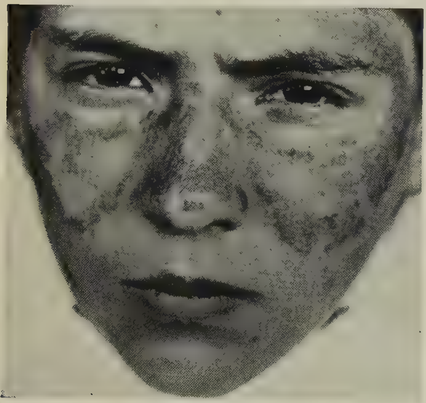

Fig. 490.—Lupus erythematosus, showing typical butterfly distribution.

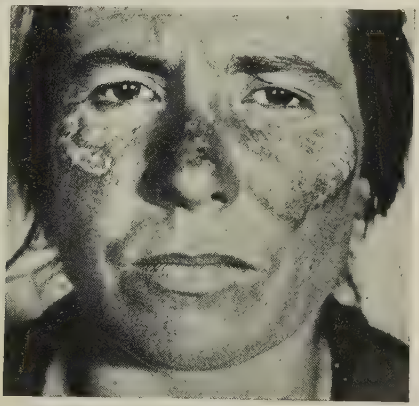

Fig. 491.—Lupus erythematosus, discoid type.

The patches are of various sizes and configurations, and may, through peripheral extension, coalescence, and the development of new patches, spread diffusely to involve entire regions, particularly the head and neck, the hands, the vulva, and the perineum.

Types.—The early lesion of the discoid type as a rule is found on the face, and may be single or multiple. It is an erythematous, slightly elevated macule covered by grayish or brownish adherent scales. The size of the lesion and its definition gradually increase, and in the course of months it may be a circular discoid plaque, a centimeter or more in diameter. Usually the central portion is not as elevated or as red as the border. The patch is covered by the characteristic scales which, when removed, reveal patulous, follicular orifices, which may contain dry horny epithelial plugs.

The course of the discoid type is variable. Spontaneous involution and permanent cure may occur without leaving any trace of the disease. More frequently, characteristic scars are produced. These are superficial, flat, smooth, pliable, white, and slightly depressed, and the epidermis over them

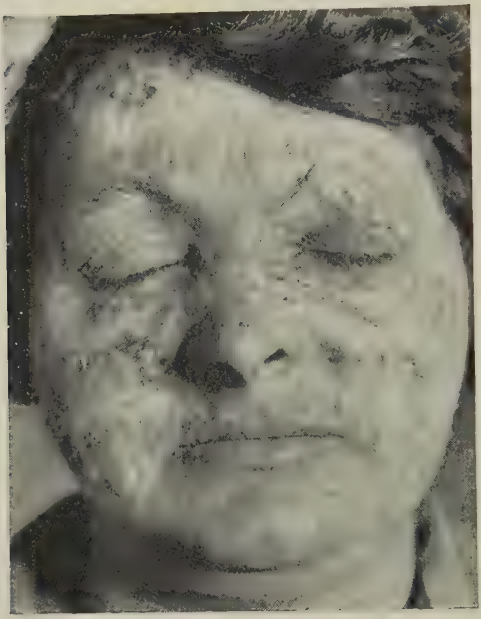

Fig. 492.—Extensive atrophy due to lupus erythematosus. Note that the nose is not shrunken as it would be in lupus vulgaris of the atrophic type.

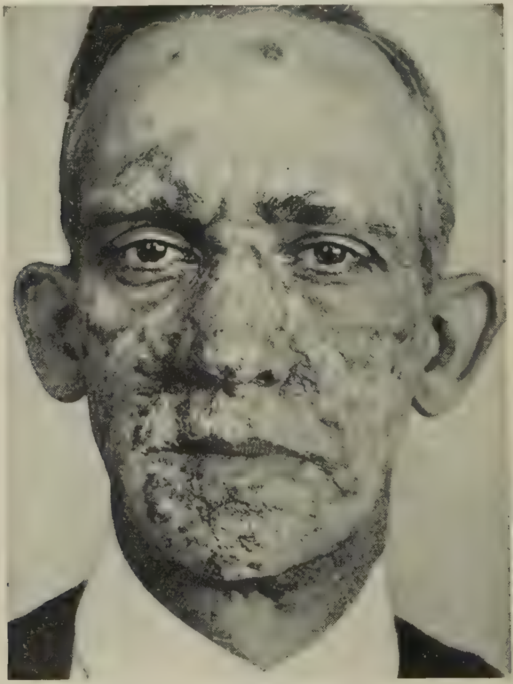

Fig. 493.—Long-standing lupus erythematosus. Patient was treated for many years by applications of liquor potassii and eventually developed an epithelioma of the left cheek, which metastasized to the cervical glands and caused death. (Courtesy of Dr. Louis Le Bel.)

may be easily puckered by pinching with the fingers. Sometimes their surface seems stippled or is telangiectatic, especially at the edges. Relapses are the rule and with each one there is usually an extension of the patch.

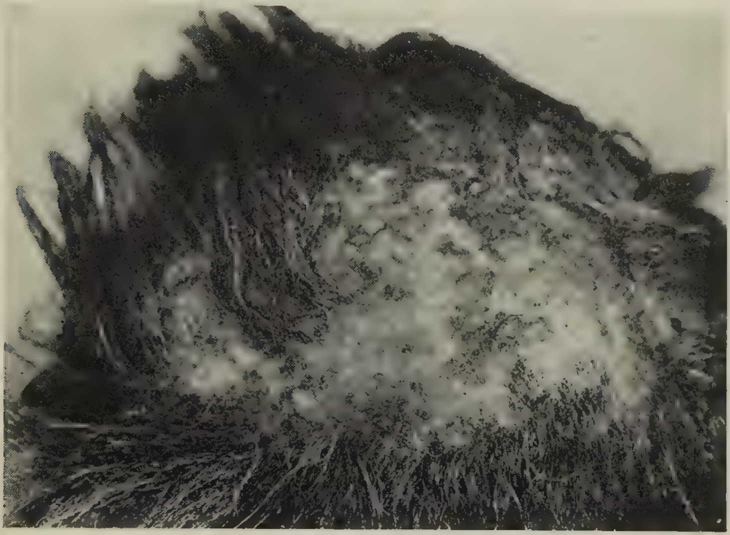

Fig. 494.—Lupus erythematosus of the scalp. Note atrophy and follicular hyperkeratosis.

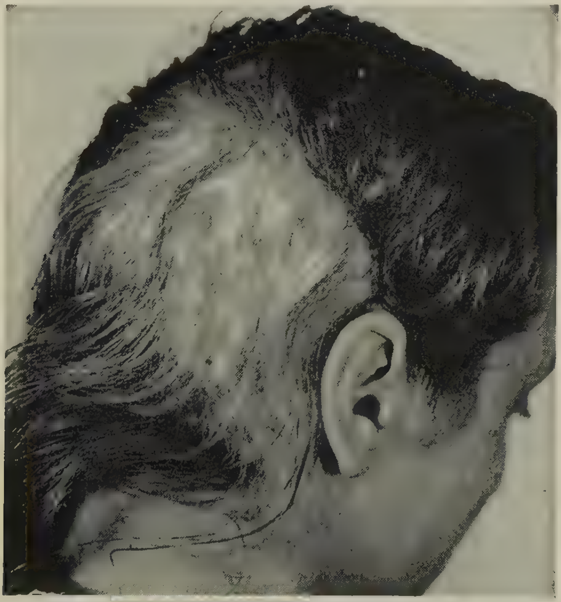

Fig. 495.—Alopecia and atrophy in lupus erythematosus of the scalp.

On the scalp the scars are more sclerotic and depressed than on other areas, and are hairless. Dilated follicles and horny plugs may be present, and often there are also active patches of the disease which are less erythematous and more horny than are usually observed in other locations. Intolerable

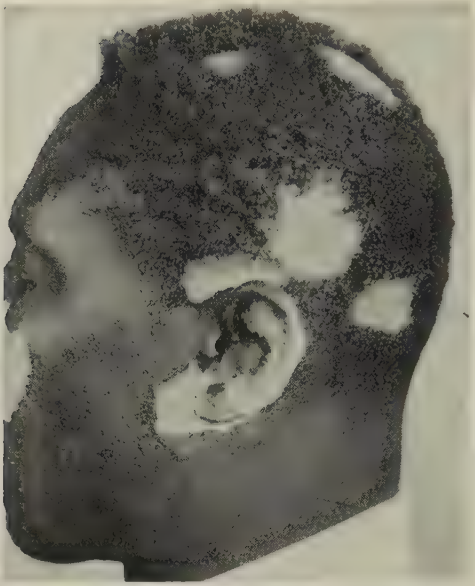

Fig. 496.—Alopecia and depigmentation caused by lupus erythematosus in a negro. The disease is uncommon in the negro race.

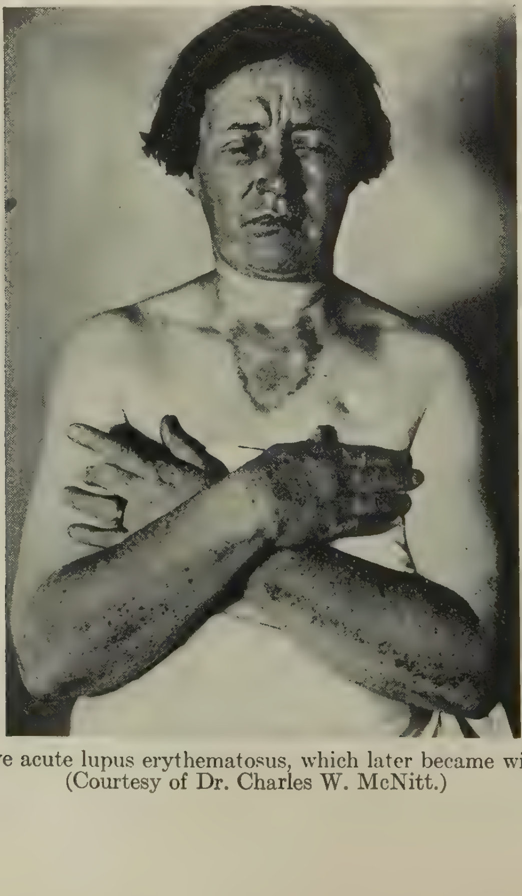

Fig. 497.—Extensive acute lupus erythematosus, which later became widely disseminated. (Courtesy of Dr. Charles W. McNitt.)

itching is a symptom peculiar to scalp involvement. On the hands and feet the patches are generally less well defined than on the face and, being a persistent erythema with slight scaling, may resemble erythema multiforme, or psoriasis, or assume the features of lupus pernio. On the lips and in the mouth the patches are grayish hyperkeratoses which may be eroded or superficially ulcerated, and are surrounded by a bluish-red inflammatory zone.

The disseminate type is often generalized and accompanied by fever. It may develop suddenly without previous manifestations of the disease or may be superimposed upon the chronic discoid variety. All degrees of severity are encountered, and, whereas in some cases there may be grave constitutional symptoms and a fatal termination, in others there may be no symptoms and the disease may undergo spontaneous regression, most of the lesions leaving no sequelae. A diffuse redness and swelling of the face may cause an appearance like erysipelas. On the extremities and trunk the eruption may be erythematous, papular, and scaling or even purpuric, telangiectatic, pigmented or bullous but most frequently simulates erythema multiforme.

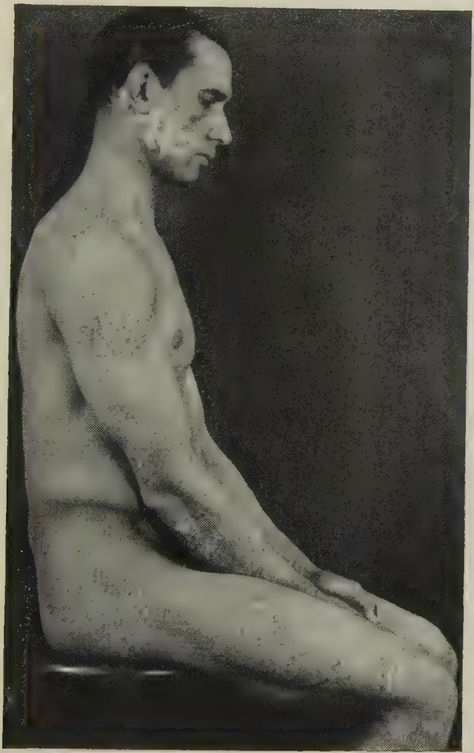

Fig. 498.—Lupus erythematosus. Extensive involvement, showing atrophic patches.

A less important and rare type of lupus erythematosus is the telangiectatic variety. This is observed principally on the face, where red spots of sizes varying from puncta to large disks occur. On close inspection one discerns that the color is occasioned solely by telangiectases. Scaling is absent; the patches may disappear and leave scars characteristic of lupus erythematosus.

Development.—The relationship of the disease to tuberculous infection has rarely been proved, and many cases seem to originate from various toxic causes. Strong sunlight, insect bites, and sudden temperature changes often seem directly provocative.

Epithelioma occasionally develops upon long-standing lupus erythematosus or vulgaris. The neoplastic change may result from irritants used in local treatment. I had one case which occurred after persistent use of potassium hydroxide solution to the cheeks. This patient had also been given small amounts of radium treatment. In a second case the patient had received no irradiation and had used various irritating medicines locally, but developed an epithelioma in the malar region. Dicke has collected 50 cases from the literature of epithelioma arising on lupus erythematosus, the majority of the lesions being of the squamous-cell variety.

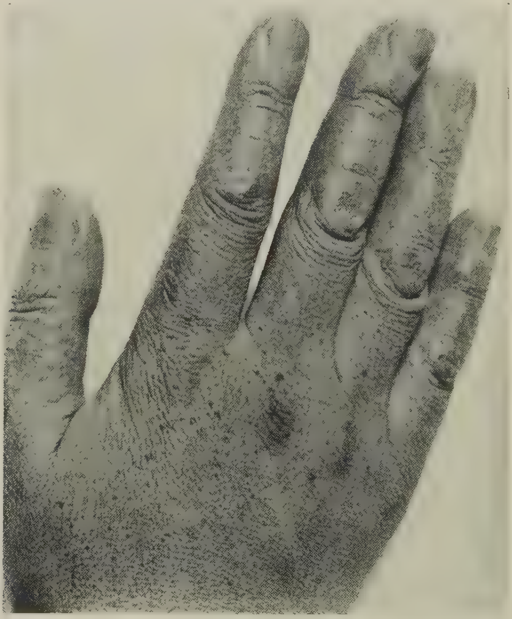

Fig. 499.—Lupus erythematosus of the fingers and back of the hand, showing atrophy, telangiectases and scaling.

Diagnosis.—Lupus erythematosus must be differentiated from seborrheic dermatitis, rosacea, lupus vulgaris, sarcoid, and tertiary syphilis. Its identification is sometimes impossible until there have been prolonged study and a microscopical examination of the tissue. Lupus erythematosus usually begins in early adult life on the flush areas of the cheeks and nose, on the ears and scalp. The lesions tend to be symmetrical and are persistent erythematous macules, often discoid or in a butterfly pattern over the nose and cheeks, as has been pointed out. They are demarcated and covered by adherent scales which, when removed, show follicular plugs on the under surfaces. The follicular orifices are dilated and there may be atrophy or telangiectasis and alopecia and, rarely, ulceration. Itching is common and often severe when the scalp is involved, but otherwise is negligible or absent. Seborrheic dermatitis occurs at all ages and is differentiated from lupus erythematosus by absence of margination, of atrophy, of dilated follicles, and of complete alopecia within the patches, by the presence of greasy yellow scales without follicular plugs, and by involvement of other areas prone to seborrheic dermatitis—eyebrows, lids, nasolabial angle, ears, sternal and axillary regions. Moderate itching is generally present.

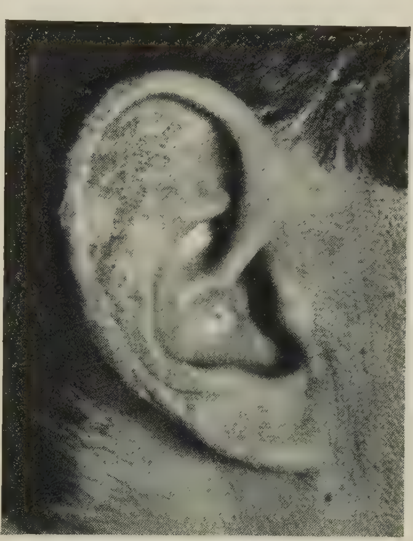

Fig. 500.—Involvement of the ear by lupus erythematosus, showing atrophy and telangiectases.

Treatment.—As lupus erythematosus is intractable, each case should be studied individually, focal infections, metabolic and circulatory derangements being corrected. The location of the lesions is also a factor modifying the selection of methods of treatment. It is scarcely necessary to remark that upon the scalp or eyelids extreme caution must be exercised in the use of local destructive agents. The patient should absolutely avoid exposure to bright sunlight or excessive cold or heat.

In acutely inflammatory, edematous, spreading lesions all local treatment except soothing applications is contraindicated. Continuous wet dressings of the following lotion are recommended:

1 part sodium chloride
2 parts sodium bicarbonate
3 parts boric acid to 100 cc. distilled water. After this, the application of lotio alba—which has special merits—calamine and zinc lotion, or the following ointment should be employed until the acuteness subsides:

℞. Liquor. alumini acetatis (liquor Burowii),
Adipis lanae..āā ℥j

Innumerable kinds of treatment are advocated for this affection after the acute symptoms have disappeared. Of the topical medicines, salicylic acid is the best, being used in an alcohol lotion which is painted upon the affected areas three or four times daily. It causes local redness and exfoliation two or three days after application, and is then discontinued for one or two days, following which the lotion is again used. This process is repeated until the lesions have disappeared. The strength of the salicylic acid may be varied from 5 to 20 per cent. It is possible to substitute resorcin for salicylic acid, but this has no particular advantages and is likely to give a brownish stain to the treated area. Bichloride of mercury may be added to either, in strength from 1 : 2000 to 1 : 500.

℞. Acid. salicylic.. 10 Gm.
Camphorae.. 2 "
Solution of corrosive sublimate in alcohol 1 : 1000, 95 per cent..q.s. ad. 50 cc.

After successive peelings, the areas are painted with phenol or trichloracetic acid. Painting of the affected surfaces with tincture of iodine may also be beneficial. Internally, quinine and iodine are of value.

The first use of *gold* for the treatment of lupus erythematosus was doubtlessly based upon the assumed tuberculous origin of the disease. Various preparations of gold have been employed (gold potassium cyanide, gold chloride, krysolgan, which is 4-amino-2-aurothiophenol carbonic acid, and triphal, which is sodium aurothiobenzimidazol carboxylic acid). Schamberg and his associates have developed a more stable and less toxic product called gold and sodium thiosulphate containing 37 per cent of gold, which is readily soluble in water. The compound is injected intravenously at intervals of five to ten days. The first dose should not be any more than 25 mg., and if this is well tolerated the dose can be gradually increased to 50, 60, 75, and 100 mg. When used over a period of three or four months the preparation is an efficacious and apparently safe remedy for this disease. Prolonged treatment with small doses is recommended, but the question of dosage, frequency of injection, and length of treatment is at present a matter of individual judgment.

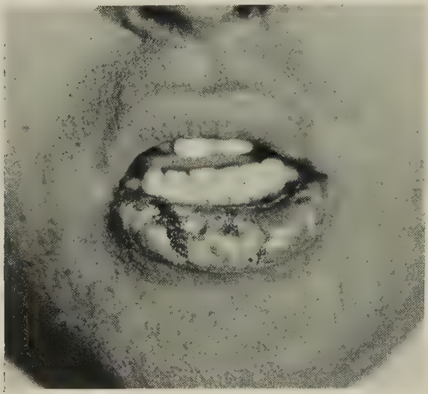

Fig. 501.—Lupus erythematosus of the lip.

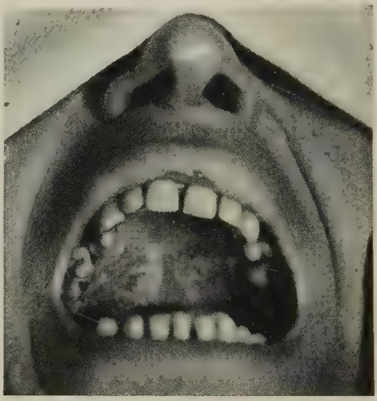

Fig. 502.—Lupus erythematosus of the roof of the mouth, showing white atrophic patches.

It is remarkable to observe the rapid influence of gold compounds in some cases of lupus erythematosus; occasionally eruptions of long standing entirely disappear after two or three injections. But in other cases prolonged treatment is necessary, and a few cases are completely resistant to the drug. The injections should be combined with the use of organic iodine in such instances. After thorough treatment recurrences are infrequent.

There is a marked difference in individual tolerance to gold and sodium thiosulphate. Some patients develop gastro-intestinal reactions with fever, chill, and prostration, while others have a cutaneous reaction which may be a pruritic, polymorphous erythema, or a lichenoid or exfoliative eruption. Hemorrhages from the stomach and uterus have been reported. Some fatal reactions have occurred, both in this country and abroad, from the use of gold preparations. In the treatment of the disseminate type of the disease it is particularly important that the dosage in the beginning be small. The contraindications are advanced kidney, liver, or cardiovascular lesions.

Tuberculin injections have been used with benefit by Cannon and Ornstein, Ravogli, and others, but hypersensitiveness is common and dangerous reactions may occur even with minute doses. Tuberculin has been given both hypodermatically in the arm for general effect and infiltrated locally into and beneath the diseased patches. The local reaction caused by the latter method frequently induces marked improvement, and occasionally patches are cured by this technic, but the results are inferior to those from other methods, particularly gold, carbon dioxide snow, or radium therapy.

Physiotherapy is important, although its use is confined strictly to the fixed or discoid expressions of the disease. Radium, carbon dioxide snow, and ultraviolet light are the principal agents.

The beta rays of *radium* give the best results, in doses sufficient to produce sharp reactions. Unfiltered radium, either the salt in a flat applicator or the emanation in small glass tubes embedded in paraffin on a spatula, is employed. The dosage should be 100 to 200 millicurie minutes per square centimeter, contact. A 10 mg. flat half-strength applicator, unscreened, being used, this dose is obtained by an application of about one hour, which will produce a moderate superficial reaction with erythema, edema, and subsequent exfoliation of the epidermis. Larger doses are at times advisable. It is recommended that there be close contact and wide inclusion of edges so as to irradiate well beyond the visible border of the lesions. During the period of reaction, the affected areas should be cleansed morning and night with mineral oil, followed by the application of a dressing of borated vaselin. A thin film spread over the area is sufficient to cause one layer of gauze of proper size to adhere to the patch so that no adhesive is necessary. When the lesions are on the eyelids, the eyeballs should be shielded by a brass screen during radium treatment (see page 196). The intervals between the treatments are from four to six weeks. The majority of cases tend to relapse and require further treatment from time to time, although I have cases that have remained cured for several years.

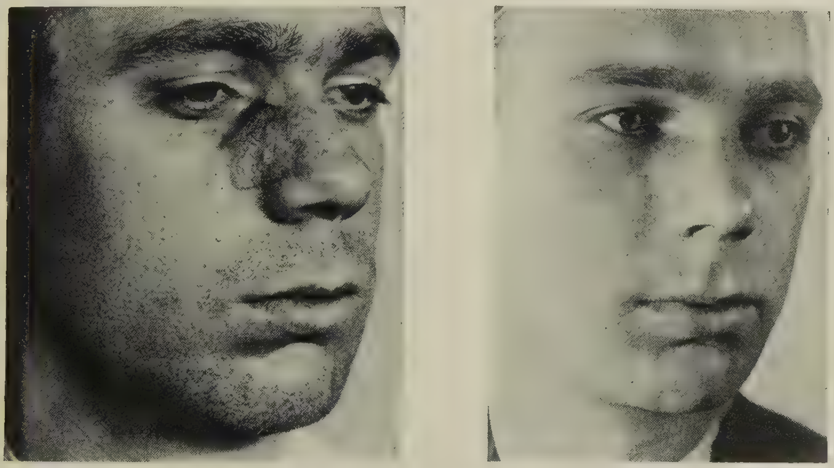

Fig. 503. Fig. 504.

Figs. 503, 504.—Early case of lupus erythematosus. Before and after treatment by gold sodium thiosulphate injections.

Heavy screening (for gamma radiation) is advocated by some authors, but I have never obtained as good results by it as by unfiltered radiation (beta rays). The beta rays being quite different from the gamma rays or x-rays and the pathology of the disease being so superficial, penetrating radiation scarcely seems indicated. However, the principal objection to screening is the unsightly scarring caused by effective dosages, whereas with unfiltered radium it is imperceptible.

Although the beta rays of radium are often helpful in the treatment of lupus erythematosus, *roentgen-ray* therapy is hazardous and generally ineffective. In the early days of radiotherapy many dermatologists used x-rays, but they have been given up because of the frequency of acute reactions with dissemination of the disease, and the tendency of the atrophic skin to carcinomatous changes. I have used roentgen therapy upon the enlarged cervical glands accompanying lupus erythematosus of the face and thus caused dissemination of the disease. The areas exposed to irradiation included the lateral surfaces of the neck, and exactly in the rectangular space lupus erythematosus appeared subsequent to the x-ray treatment. Similar outbreaks of acute disseminate lupus erythematosus confined precisely to areas irradiated have been observed by MacKee and Wise.

Goeckerman has had favorable results in cases of the acute disseminate type from filtered roentgen therapy over the gland-bearing regions of the body. Beneficial results, when seen, occur a few days after treatment. The rationale of this method is based upon the theory that the cause of lupus erythematosus lies in the glandular system. The following technic was used:

1. For cervical, axillary, and inguinal regions—135 kv. at 12-inch distance, 5 ma., with a filtration of 4 mm. of aluminum for ten minutes.
2. For chest and abdomen anteriorly and posteriorly—135 kv., at 12-inch distance, 5 ma., with a filtration of 6 mm. of aluminum for ten minutes. Treatments were repeated every six to eight weeks to a total of five to six exposures. The lesions were not directly exposed to the x-rays.

Supersoft x-rays (w-rays) caused temporary improvement in a few cases, always followed by recurrences. In other instances, this treatment was irritating and provoked an extension of the disease.

Local application of the high frequency desiccating current has not given good results in my hands, as recurrences are so frequent. This has been a common experience with others. Better results are obtained by applications of trichloracetic acid, especially on the scalp.

Carbon dioxide snow was first used in the treatment of disease by Pusey (1907), and his method is second only to gold therapy in the treatment of lupus erythematosus. The most convenient manner of obtaining CO_2 snow is as "dry ice," which is now in general use. Liquified carbon dioxide is also furnished in iron tanks under heavy pressure. To collect CO_2 snow, and not gas, when the nozzle is opened, the tank should be placed in a slanting position with the nozzle at the lower end covered with a perforated metal cylinder or cone. Several sizes of metal cylinders and cones are at hand, and the operator chooses the size which conforms to that of the area to be treated. The nozzle is opened, and the escaping CO_2 evaporates so rapidly that it forms snow in the cylinder in a loose white mass, which becomes packed by the pressure. Sticks of snow thus made can readily be pared by a knife to any desired shape. Equal freezing in areas larger than one square inch is difficult, so it is better to make cubes of snow not larger of face than 1 inch,

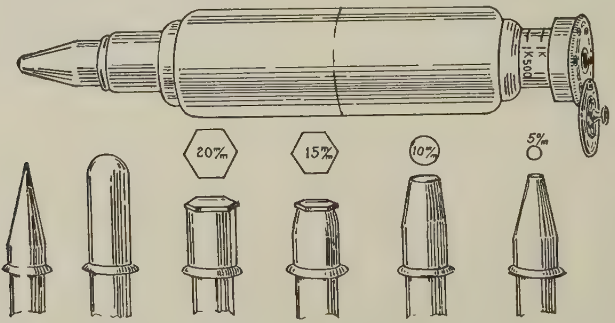

Fig. 505.—Cryocautery of Lortat-Jacob, showing the instrument, pressure gauge, and various tips.

these being used to freeze contiguous areas. For treating small lesions one should use snow firmly packed in cylindrical molds by a small mallet. If packed firmly enough, a hard translucent ice pencil is formed, not larger than 1/16 inch, and this is brought to a fine point for treating minute lesions.

In recent years the cryocautery invented by Lortat-Jacob has been substituted as a more precise instrument of refrigeration. The instrument for cryocautery is composed of:

1. A central metal tube terminating in a point of copper, the other extremity having a stopper perforated in its center by openings of graded sizes. Each apparatus is supplied with various tubes of this type, some ending in points, some in flat or convex surfaces, round or square and of different sizes. They are conductors of cold and sterilizable.
2. A muff of flexible metallic cloth several millimeters less in diameter than the tube. The upper end is provided with a ring which fits upon a collar on the tube; the lower end stops several millimeters short of the copper point.
3. A spiral spring surrounds the tube and is arranged to record the pressure exerted (from 500 Gm. to 2 kg.) by the application upon the skin.
4. A removable fiber envelope.
5. A cylindrical ferule.

The best freezing mixture is made by adding acetone to carbonic snow obtained from liquid carbonic acid, which is used for many purposes in commerce where it is procurable in steel cylinders under a pressure of 50 atmospheres at 15 degrees. When the stopper of such a cylinder is removed and the liquid let out, the sudden decompression produces such a lowering of temperature that instant solidification results. The temperature of the snow is −80 C.

The technic is subject to variation, depending upon the therapeutic indications and unequal sensitivity of diverse types of skin. The application varies according to duration and pressure, the latter being generally 1 to 2 kg. The duration ranges from two to thirty seconds, usually eight to twenty-five seconds for the fixed types of lupus erythematosus or thirty seconds for lupus vulgaris.

Chiefly, three effects are obtained in the treatment of dermatoses: (1) Vascular obliteration due to the susceptibility of the endothelial cells of the blood vessels to cold, even in small exposures; (2) alteration in the cells themselves due to successive freezing and thawing; (3) the exudation of serum and cellular elements. Moderate pressure and short exposures frequently repeated give results far superior to more drastic infrequent treatments, the resulting scars being minimal but, with either technic, pliable, white and firm. Conservative technic is specially desirable on lesions near bone or cartilage.

Ultraviolet light is a valuable agent for the treatment of selected cases of lupus erythematosus. In the acute stages or where there is a tendency to dissemination its use tends to irritate and spread the disease, but in the more common discoid fixed types good results are usually obtained by local treatment. However, even in this type caution must be exercised, for dissemination may occur after the application of ultraviolet light.

Very strong doses of five to thirty minutes should be given, preferably through a quartz lens with compression. Such dosage causes local congestion, blistering, and exfoliation. As the reaction subsides, the lesions involute. The disease generally causes scarring, which is not augmented by the treatment. Pressure exposures should be repeated after the blistering has subsided and preferably while the erythema is still present. Where the lesions are extensive, they may be divided into sections, each of which is treated on successive days. The results of this treatment are gratifying but unfortunately are usually temporary. Permanent cures by this method are so rare that they are unique, and therefore the value of ultraviolet light in the treatment of lupus erythematosus is inferior to injections of gold sodium thiosulphate, freezing with carbonic acid snow, and the application of unfiltered radium, but in some cases, however, which have not been helped by these methods, ultraviolet light has had excellent effects. Generalized treatment with ultraviolet rays is occasionally employed, but even small doses may cause local aggravation or dissemination.

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CHAPTER XXIV

OTHER DISEASES DUE TO BACILLI

LEPROSY

Synonyms.—Elephantiasis graecorum, lepra arabum, leontiasis, lepra.

Leprosy is a wasting constitutional disease caused by the Bacillus leprae, which is characterized chiefly by lesions of the skin and nerves with resulting mutilations, usually ending in death.

Leprosy is infectious, being endemic in certain parts of the world. The history of the disease shows that it spread extensively over Europe, England, and Scotland during the Middle Ages and then gradually decreased in frequency in these parts until it is at present scarce. It is still endemic in Iceland, Norway, Sweden, Asia, Polynesia, Africa, South America, Central America, and the West Indies. Many of the cases encountered in our clinics occur in those who have lived in Austria, Southern Russia, Sicily, or the West Indies. In the United States[1] leprosy is most prevalent in Louisiana, Texas, Florida, and in California, probably due to importation from the West Indies and China, and it also is met with frequently in the Middle Northwest and the valleys of the Missouri and LaPlatte. In the large cities of the country, cases of leprosy occur, but as has been said, mostly in those who have contracted the malady in other parts of the world before coming here. The classes of persons affected are chiefly immigrants, enlisted men in our army and navy, and those predisposed to the disease and liable to contact with it on account of race, family, and custom. The number of cases in the United States is variously estimated, most observers agreeing that 1200 is a conservative figure.

Etiology.—The bacillus of leprosy was discovered by Hansen in 1879. Its demonstration is now an important diagnostic procedure. In tissues the bacilli are small slender, acid-fast, pointed rods similar to the tubercle bacilli but somewhat shorter and less frequently curved. Stained preparations show unstained spaces resembling those seen in the tubercle bacillus, with which the staining qualities are almost identical. The chief difference between the organism of tuberculosis and that of leprosy is that the former may be cultivated on suitable media and successfully transmitted to laboratory animals, while such results have not been attained with the latter. The bacilli are prevalent in all diseased areas, especially in the skin nodules and on the mucous membranes of the nose, eyes, and gums, where they may be identified by

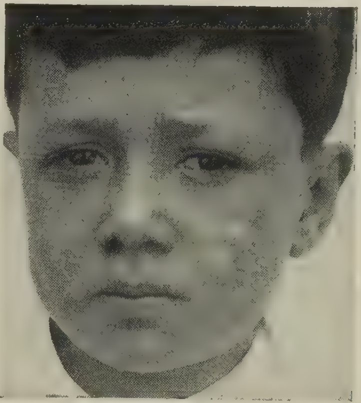

Fig. 506.—Leprosy. Typical early depigmented macular patch in a child. (Courtesy of Dr. Richard P. Strong.)

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[1] Hopkins, R., and Denney, O. E.: Leprosy in the United States, J. A. M. A., 92: 191–198, Jan. 19, 1929.

smears, which may be obtained by incising a lesion and curetting the edge of the cut. After the lesion has been blanched by pinching it between the fingers, it is cut by the point of a scalpel. The incision should not extend sufficiently deep to cause bleeding. A small bit of tissue without blood may then be removed from the cut edge by turning the blade, and this is placed upon a slide and stained with carbolfuchsin. A small punch may be used to remove a piece of mucous membrane from the nose for the same purpose. In trophic skin lesions secondary to involvement of the peripheral nerves and in early macular eruptions, the bacilli are absent or very sparse. Internal use of potassium iodide has been found by Rogers to increase the number of bacilli in the nasal discharge. The serum in blisters produced upon the skin by carbon dioxide snow may contain the bacilli. Schröpl demonstrated them from apparently normal skin by this technic. In tissues they occur chiefly in large phagocytic, vacuolated, oval or round cells known as leprosy cells. The leprous nodule is composed almost entirely of these cells containing enormous numbers of bacilli. Such cells are probably derived from the histiocyte.[1] Occasionally the cells are multinuclear and the size of giant cells. The bacilli are often concentrated around the hair follicles, sebaceous and sweat glands, and they have sometimes been found in them. Eruptions of short duration may show only a few bacilli. During acute exacerbations in which there is a development of new lesions, bacilli have been found in the blood.[2]

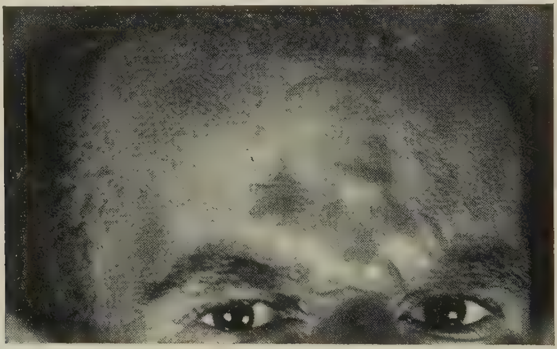

Fig. 507.—Early lesions of nodular type of leprosy. (Courtesy of Dr. A. Benson Cannon.)

Transmission.—Little is known concerning the transmission of the disease. In spite of many attempts to inoculate healthy individuals with lepra bacilli, little has been proved. Sisters of charity and others who have been exposed to the disease for many years have escaped infection except in isolated instances. Individual susceptibility to leprosy is probably requisite to its development. Whether the disease is transmitted from mother to offspring during intra-uterine life is as yet undetermined. In this connection and in general the nature of leprosy probably runs parallel to the known facts concerning tuberculosis, to which disease a remarkable resemblance exists. This is made even more impressive, as pointed out by Park and Williams, by the fact that leprosy reacts both locally and generally to an injection of tuberculin in the same manner as tuberculosis but to somewhat less extent.[1] Reports of cases infected with the disease by accidental puncture wounds give weight to the theory that leprosy might be transmitted by biting insects. Of the common insects, the bedbug has seemed the most likely carrier. Uncleanliness is certainly an important predisposing cause.

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[1] Oliver, J.: The Origin of the Lepra Cell, J. Exper. Med., 43: 233–239, Feb., 1926.

[2] Park, W. H., and Williams, A. W.: Pathogenic Micro-organisms, Ed. 8, Phila., Lea & Febiger, 1924, p. 453.

Since the mode of infection is undetermined the incubation period is only a matter of conjecture. The onset is usually insidious and there is probably no uniform time between the inoculation and the development of symptoms for the period is one of reaction between the defense forces of the body and the invading micro-organism. In these respects leprosy resembles tuberculosis rather than any of the exanthematic fevers.

Symptomatology.—Generalization of the infection may be accompanied by fever and other symptoms of bacteriemia. The fever is likely to be intermittent and there may be periods of several weeks or months between attacks. The rise in temperature is accompanied by aching of the bones, headache and, at times, epistaxis. These prodromal symptoms are often so slight that they invoke no special attention, and the disease is not recognized until the appearance of a cutaneous eruption. The earliest lesions occur in the mucous membrane of the upper respiratory tract. Morrow and Lee state that hoarseness is an early manifestation of the nodular type, due to the presence of lesions in the larynx and pharynx. Generalized itching is not infrequently present. The eruptions on the skin are manifold. The course of leprosy is protracted, lasting from five to thirty years and ending in death, which usually occurs from visceral involvement or intercurrent disease.

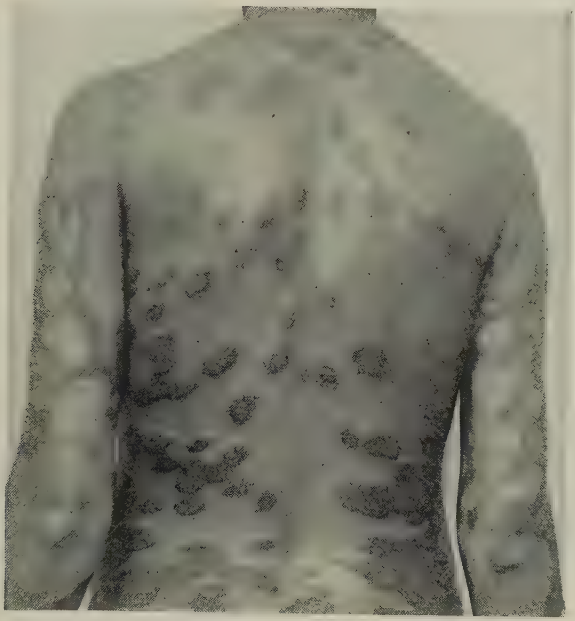

Fig. 508.—Leprosy—generalized macular eruption. (Courtesy of Dr. A. Benson Cannon.)

Most often the first lesion that is noticed is a depigmented patch, which may be the site of sensory disturbances. Other early eruptions are more or less generalized and symmetrical, taking the form of macules, plaques resembling erythema multiforme, or pigmentary disturbances, whereas the later eruptions tend to be localized and become nodular, tubercular, or ulcerated or consist of trophic disturbances due to leprous neuritis. Such later manifestations are respectively classified as the nodular type or the anesthetic type of leprosy, mixtures of the two being common. These are sometimes called the mixed type and include the features of the two varieties already described. The division is arbitrary but serves to emphasize the predominant features of the case. Some cases are mixed from the beginning, whereas others begin with the nodular type and are followed by maculo-anesthetic and nerve lesions or the opposite sequence may occur, though less often.

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[1] Park and Williams: Loc. cit., p. 454.

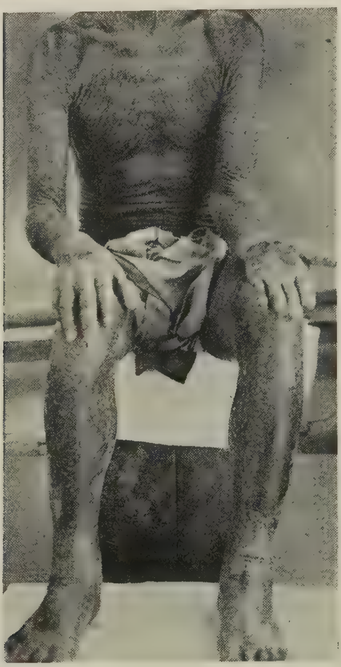

Fig. 509.—Moderately advanced nodular leprosy, with diffuse leprous infiltration. This case has just had severe lepra fever; there is generalized desquamation of the epidermis following an acute inflammation of the infiltrated areas. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

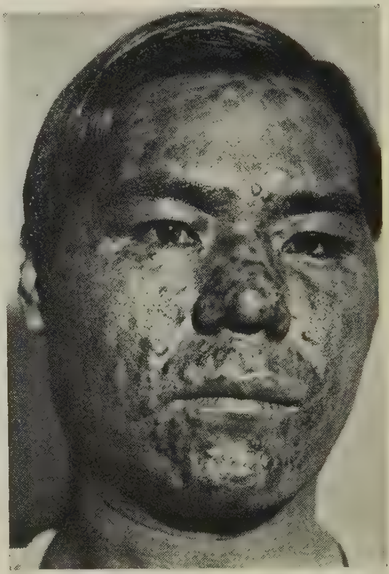

Fig. 510.—More advanced case of nodular leprosy.

Acute periodic outbreaks of skin lesions characterize the course of the disease, these attacks being preceded by vague pains, and followed by fever. Erysipelas, which is a common complication in leprosy, occasionally develops in the affected skin, and there may be a brawny edema of the face and extremities, and nephritis due to continual passage of bacilli through the kidneys.

The *macular eruption* is usually extensive and symmetrical, with lesions which are larger than those characteristic of syphilis. As a rule the subpectoral creases and the midline of the back are not involved. Less commonly the macular lesions are small and are confined to one or two regions. However, the patches usually vary from 1 or 2 cm. in diameter to palm size or even larger, a certain uniformity of size being the tendency in any one case. The lesions are variously shaped, generally being rounded or lobulated, and may or may not be infiltrated. The color varies from a light pink to a purple, mahogany, or brown and there may be depigmented spots all intermingled so that the appearance is dappled. The lesions may be slightly atrophic, hyperesthetic, or anesthetic. The larger patches may be configurate and shaded deeper centrally or peripherally.

Hyperpigmentation and depigmentation are common, and often macules which are first erythematous later become pigmented, or lose their pigment and become slightly atrophic. In the affected areas the hair falls out. The loss of the eyebrows is an early and characteristic symptom. The scalp is, strange to say, not affected, but a mottled alopecia of the bearded region is common.

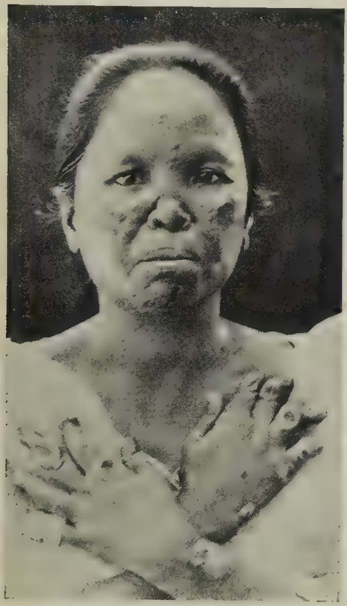

Fig. 511.—Advanced mixed leprosy. Note the beginning deformity of the fingers and atrophy of the fingertips. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

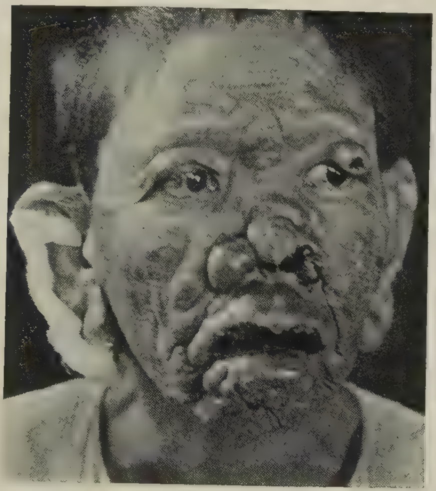

Fig. 512.—Advanced nodular leprosy. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

Sites of predilection for the macular eruption are the supra-orbital region, the nose, ears, and cheeks; the dorsa of the hands; the extensor aspects of the extremities, and the trunk. The macules of skin leprosy apparently are caused by the presence of far greater numbers of bacilli than exist in the macules of nerve leprosy, and probably the latter do not conform in distribution with those of the skin type. Hopkins, Denney, and Johansen made a survey of 302 lepers and concluded that certain regions are immune to skin lesions, namely, the posterior-inferior auricular area, the concha, the orbital side of the nose, the lateral palpebral area external to the outer canthus, the axilla, the inframammary fold in women, the interdigital surfaces, and the perineum.

The macular variety of eruption may persist indefinitely but usually there are added symptoms of nerve involvement, motor or sensory, or nodular infiltrations, and not infrequently these changes predominate so that the manifestations become almost completely atrophic or nodular.

Nodular Type.—The nodular or tubercular type of eruption is a common form of the disease. This type is distinctly a leprous involvement of the skin, whereas in the anesthetic type the skin changes are secondary to nerve involvement. The cutaneous lesions of the nodular form, called lepromas, are ushered in by fever, and may appear subsequent to the macular eruption after a varying period, or without preliminary manifestations. The early nodules are often ill-defined infiltrations, slightly anesthetic, and devoid of hair, and occur in the supra-orbital region or on the ears, although other areas may be the first to show such lesions. The forehead and other parts of the face, the ears, and the hands are, however, sites of predilection. The lesions gradually become better defined and consist of yellowish-brown or brown subcutaneous thickenings, which may become confluent and in the course of years produce characteristic disfigurement of the facies, the appearance resembling that of a lion. The nodules may involute spontaneously, especially after an attack of fever, or they may increase to form large plaques or they may ulcerate. On palpation they are firm and somewhat elastic before ulceration supervenes. The ulcers are indolent and covered by a seropurulent exudate. They are more common on the extremities, particularly on the extensor surfaces where they tend to become destructive and lead to mutilation unless they respond to treatment. Lichenoid papules (lichen leprosus) are encountered, usually appearing upon the abdomen in groups of follicular, hard, somewhat yellowish lesions which resemble gooseflesh except for the grouping and the sharp boundary of the patch.

Most cases of leprosy show lesions of the eyes where corneal and conjunctival infiltrations and extensions of the disease into other optic structures may lead to blindness and shrinkage or ulceration of the eyeball.

The mucous membranes are also attacked, especially those of the nose, mouth, and throat. In 96½ per cent of 1200 frank cases Samson and Lara obtained positive smears from the nasal septum. By far the most common lesions in the nose are infiltrations and nodules, but perforation of the septum takes place fairly often. These authors found a high percentage of positive smears in cases in which the mucosa was apparently normal or simply congested. The nodules occur on the vocal cords causing the voice to become harsh and, at times, interfering with respiration. The hair and the nails fall out, as stated, particularly the hair of the outer half of the eyebrows. After a long duration the palpable lymphatic glands become moderately enlarged.

Anesthetic Type.—Anesthetic or nerve leprosy is the form which is said to predominate where the disease has been prevalent for a long period. As in the nodular type, the preliminary macular eruption and fever may be severe, mild, or completely lacking. The leprosy bacillus produces an inflammation in the interstitial tissue of the nerve trunks within the sheath, in the perineurium, and sets up a connective tissue reaction, which by compression causes a secondary degeneration of the nerves. In this form of multiple neuritis, the Bacillus leprae is found in the nerves. Clinically, along the course of the affected nerves, especially the ulnar, peroneal, sciatic, median, radial, and the branches of the cervical plexus, beaded enlargements, nodules, or spindle-shaped swellings are found, which at first may be tender. The ulnar nerve near the internal condyle of the humerus may be as thick as the little finger. As a result of the degeneration of the nerves there gradually develop girdle sensations, areas of anesthesia, paralysis, and trophic disorders in the peripheral parts of the extremities. The skin lesions are usually at first erythematous patches which are well defined and, at times, scaly or a little elevated. The color varies from a light pink to a dark red or brown, but in the course of time becomes darker and the redness disappears, so that the patches become hyperpigmented, or depigmented. By confluence several patches may unite to form large areas that have scalloped irregular borders. Within the patches the skin is dry, crinkled, atrophic, and often hairless, especially

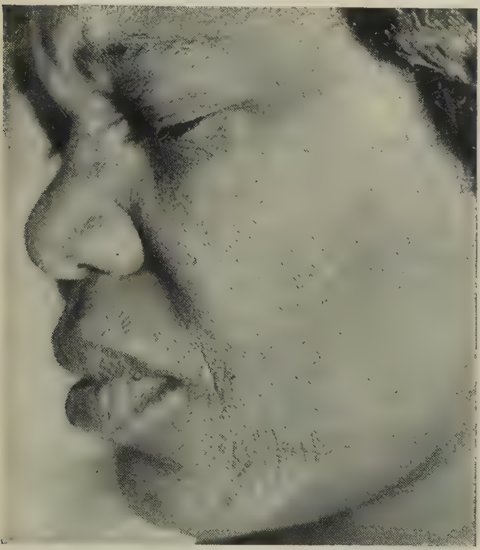

Fig. 513.—Maculo-anesthetic leprosy. Note fine crinkling of the skin in the atrophic patches.

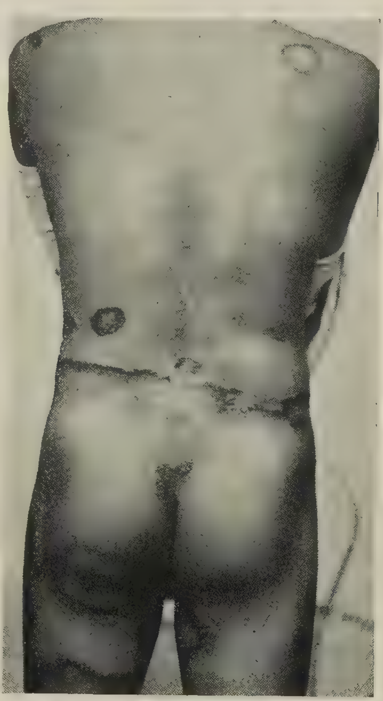

Fig. 514.—Leprosy—maculo-anesthetic type. (Courtesy of Dr. Edward A. Oliver.)

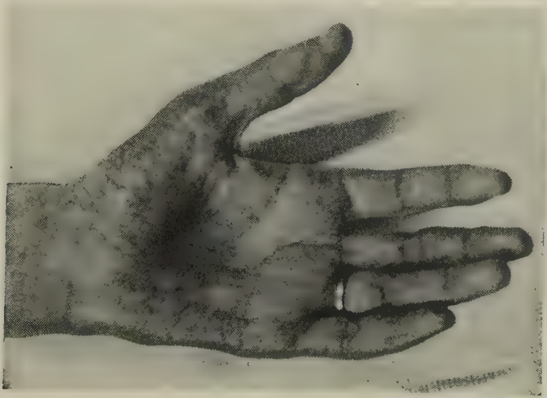

Fig. 515.—Atrophy of the interosseous muscles in nerve leprosy. (Courtesy of Dr. A. Benson Cannon.)

towards the center, and there is some hyperesthesia or beginning anesthesia. The sensory changes begin in the center, hyperesthesia being followed by anesthesia, and spread gradually to involve the whole patch, so that at any one time the center may be hyperesthetic or anesthetic, and in the latter case surrounded by a zone of hyperesthesia unless the loss of sensation has spread to involve the whole patch. At times the sensory changes in large patches are distributed irregularly due to variations in the involvement of the filaments supplying the area. Thus these areas do not usually conform to the distribution of any particular nerve nor are they symmetrical for, as stated, their location depends solely upon which branches of the nerves are compressed by fibrosis. The impaired sensibility may affect tactile, thermal, and pain pathways, or any one of these, in varying degrees, and often there are sensations of numbness, tingling, or burning in the affected parts. The anesthetic areas occur most often on the hands and feet, forearms and legs, and on the back.

Occasionally during the course of this type of leprosy bullous lesions develop upon the hands, feet and elbows, and raw exudative surfaces may result from the breaking of these bullae. Eventually they heal, leaving pale anesthetic scars with hyperpigmented edges. These manifestations, called pemphigus leprosus, are characteristic of the anesthetic type.

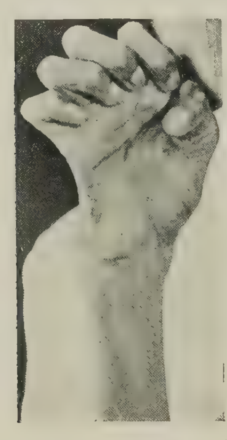

Fig. 516.—Anesthetic leprosy, showing the claw deformity of the hand. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

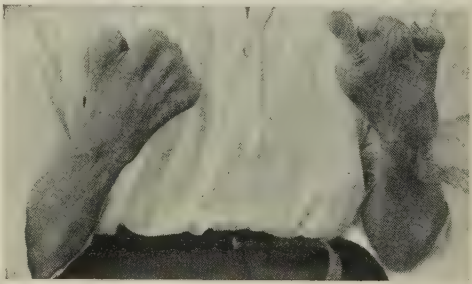

Fig. 517.—Anesthetic leprosy showing the spontaneous mutilation of the fingers. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

Paralysis generally affects the small muscles of the hands and feet or some of the facial muscles, producing progressive atrophy with degeneration. The fingers develop contractures with the formation of the leper claw, and the tips of the fingers, as well as the bony structures within, become disintegrated and, as a result of dry gangrene, fall off. Frequently a perforating ulcer develops in the ball or heel of the foot. The M. platysma, particularly the M. orbicularis palpebrarum and the M. orbicularis oris, are the facial muscles most affected, leading to ptosis, ectropion, and an expressionless appearance. The extrinsic ocular muscles may be involved with resulting strabismus and diplopia.

Diagnosis.—The recognition of a large proportion of early macular skin cases and nearly all early nerve cases, as shown by Muir, must be made on clinical grounds as they are negative bacteriologically. Repeated smears from the nasal mucosa, from the serum of a curetted papule, and even from recently broken-down nodules in an undoubted case of leprosy are frequently negative. It is therefore important to recognize anomalous forms of the disease, which may simulate keratosis pilaris, recurrent erysipelas, milium, acne pustulosa, scleroderma, pellagra, lichen planus, erythema nodosum, or fissured eczema. Other cases of leprosy resemble lupus vulgaris, granuloma annulare, erythema induratum, or sarcoid and there are occasional cases in which the patches are unusually "pityriasic," "psoriasic," or "ichthyosiform."[1]

In regions where leprosy is not endemic, its diagnosis is confused with syphilis, lupus vulgaris, erythema multiforme, and syringomyelia. Under such circumstances, mistakes in diagnosis are due to carelessness rather than to a lack of knowledge, but even those who are closely in touch with the disease at times find its identification difficult, especially in early or inactive cases.

When there is doubt, areas of anesthesia should be sought as they are usually present in leprosy, especially in the center of the macular spots, or in their depigmented sequelae, or in old nodules. The earliest sites where infiltration can be palpated are usually the forehead, particularly in the supranasal region, and in the nasolabial fold.

The course of leprosy is exceedingly slow as compared with the eruptions of erythema multiforme and tertiary syphilis, in which the duration of the lesions is a matter of months or weeks. The nodular form of leprosy produces a distinctive leonine appearance which is not present in syphilis, and when there is nerve involvement the ulnars are thickened and nodular, and there are zones of sensory disturbance. The Wassermann reaction in leprosy may be mildly positive but has not the strength that is encountered in most cases of tertiary syphilis. Of greater importance than the Wassermann test is the finding of lepra bacilli in smears from the nose or from the tissues, or in sections. In lupus vulgaris there are characteristic apple-jelly nodules which are soft and often appear within the scars. By guinea-pig inoculation tubercle bacilli may be demonstrated. A loss of pain and temperature sensibility associated with unimpaired tactile sensibility may occur, as in syringomyelia, but the two diseases are differentiated by the distribution of the anesthesia, which is usually more extensive and predominant in the upper extremities in syringomyelia, in which there are also trophic disturbances in the skin, muscles, and articulations; and spastic paraplegia. In leprosy, nodules are felt along the course of the nerves and there are usually cutaneous macules, nodules, or pigmentary disturbances, and demonstrable bacilli.

The coexistence of syphilis and leprosy, and yaws and leprosy has until recently been difficult to determine, because the Wassermann reaction in leprosy, particularly of the nodular type, is often positive. Refinement in the technic of the Wassermann test, however, has eliminated some of the confusion, and the discovery of the Kahn test has made it possible to distinguish accurately between these diseases. The Kahn test is negative in uncomplicated cases of leprosy, and is therefore preferable to the Wassermann test for the detection of coexistent treponematous infections in lepers. In leprosy there is no production of reagin similar to that in yaws and syphilis.

In all doubtful cases the clinical diagnosis may be confirmed by a microscopical examination of tissue excised from one of the lesions, or by a demonstration of bacilli in the nasal discharge, or in tissue fluid obtained from a nodule, as already described.

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[1] Motta, J.: The Importance of Diagnosis in the Prophylaxis of Leprosy; Anomalous Forms of the Disease, Arch. de hyg., 1: 103–118, 1927.

Treatment.[1]—The most important problems in the treatment of leprosy are prophylaxis and early recognition of the disease. Rogers has shown that 80 per cent of the infections occur through living in the same house with a leper and that the incubation period in four fifths of the cases is under five years. It is therefore an urgent matter that all of the leper's household and other close contacts be minutely examined for signs of leprosy every six months for a period of five years, and that segregation be rigidly enforced. There is no doubt about the contagiousness of the disease, and childhood is known to be the most susceptible period. The chief argument against segregation is that it drives off patients in the early stages from seeking medical advice. Muir, in a survey made in Bengal, found that there were three or four early cases for every advanced census-returned one. If the majority of early cases could be discovered and effectively treated, great strides could be made rapidly.

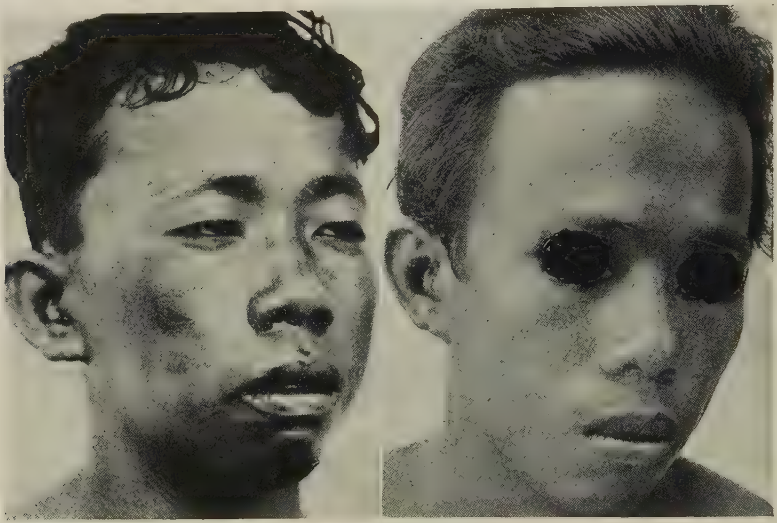

Fig. 518.—Leprous infiltration of the malar eminences, chin, and nose. Before and after treatment. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

It is difficult to judge the results of treatment on account of the likelihood of prolonged remission and the variable course of the disease, so that it is advisable to use the term "arrested" instead of "cured."

Complete recovery is the exception rather than the rule. Treatment should be continued until all signs of activity have been absent for at least two years. The disappearance of active signs means that no bacilli are demonstrable, the macular lesions show no inflammation, the anesthetic areas no change, and all the nodules and ulcerations are entirely involuted. The nasal mucosa is the seat of persistent lesions in some apparently cured cases.

Treatment is most effective in early cases in young strong individuals. A change of climate, good food, and proper hygiene exert a beneficial influence. Complications such as syphilis, tuberculosis, nephritis, and anemia are unfavorable. However, even in advanced cases a considerable proportion (15 to 20 per cent)[1] can be apparently cured if treated intensively under proper conditions.

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[1] Those who desire more information than is here given are referred to the Bibliography.

Treatment of leprosy is both systemic and local. The principal kinds of internal therapy are (1) treatment by chaulmoogra oil and its esters; (2) silver and gold therapy, and (3) vaccine and protein therapy.

Chaulmoogra Oil and Its Derivatives.—Various preparations of chaulmoogra oil are used by mouth, intravenously, intramuscularly, subcutaneously, or *per rectum.* The administration of the drug by mouth has been largely displaced in recent years by the mixed ethyl esters of the fatty acids of chaulmoogra oil to which 0.5 per cent of metallic iodine is added to reduce irritation. The esters are usually given intramuscularly or subcutaneously once a week. This treatment may be combined with the intravenous use of solution of sodium gynocardate. Recently the injection of drugs directly into and beneath the skin lesion (plancha method) has given better results in conjunction with the intramuscular injection than have been obtained by the latter method alone.[2]

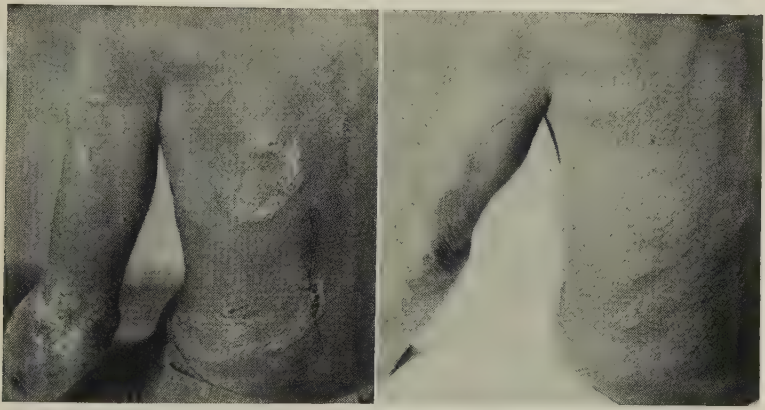

Fig. 519.—Leprosy, showing circinate lesions, which are practically always anesthetic. Before and after treatment. (Courtesy of Dr. Casimiro B. Lara, Culion, P. I.)

It is generally accepted that the inability of the human organism to overcome infection by Bacillus leprae, as well as by B. tuberculosis, is due to their inert and protective fatty capsules and acid fastness. Probably some reaction occurs between the fatty capsule of the bacillus and the fatty acids in the medicament. It is possible that the capsule is weakened so that the antibodies of the host are more effective. The principal bactericidal substances in chaulmoogra oil are the fatty acids of the chaulmoogra series, chaulmoogric and hydnocarpic acids, and possibly some isomers.

The use of chaulmoogra oil and its derivatives is not free from limitations, as the tolerance of the patient at times is low. Excessive dosage by mouth is liable to cause nausea, vomiting, and malaise, while the injections are sometimes attended by considerable pain and anorexia. Such ill effects become so severe that it is frequently necessary to stop the use of these drugs and resort to other therapeutic agents.

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[1] Wade, H. W., and Lara, C. B.: On the Value of Present Methods of Treating Leprosy, Lancet, 1: 597–599, March 19, 1927.

[2] Lara, C. B.: Evaluation of the Results of Treatment of Leprosy with the Chaulmoogra Derivatives, J. Philippine Islands M. A., 8: 263–272, June, 1928.

The ethyl esters are generally injected intramuscularly into the hip or buttock, the beginning dose being 0.5 cc. This dose is increased 0.25 cc. each week until a maximum of 4 cc. is reached, the amounts being modified by the toleration of the patient, and by the age and weight. Slight reactions are inconsequential and may even have a favorable effect, but if they are severe, the dosage remains unchanged or is decreased.

Other Internal Remedies.—On the basis of the good results obtained in tuberculosis, gold therapy in leprosy was begun in 1914. Numerous preparations have been employed intravenously with varying results, but it has been shown that gold and silver are effective remedies in the treatment of leprosy, although the beneficial effects have not justified the extended or routine use of these drugs. Their action seems to be a stimulation of the protective forces of the body rather than a direct lethal influence upon the bacilli. The drugs that have been employed are krysolgan, trifal, aurophos, solganol, and mixtures of gold and arsenobenzol, and thiosulphates of gold and sodium.

Antimony has been successfully employed in leprosy, the best results being obtained when chaulmoogra oil is given simultaneously. The preparations used most frequently are the wine of antimony and potassium antimony tartrate (tartar emetic), a 1 per cent solution of the latter being injected intravenously. These drugs have irritating and harmful properties which necessitate their cautious use, especially in debilitated subjects. Rodriguez and Eubanas claim that the use of tartar emetic instead of the more efficient and less injurious drugs now available is not justifiable.

Potassium iodide is an effectual remedy in all stages of leprosy, and Muir believes that in cases in which a large amount of leprous granulomatous tissue has been formed the breaking down of this tissue by potassium iodide apparently induces a considerable degree of immunity. The drug may provoke reactions such as an increase in the inflammatory signs in existing lesions, or fever. It is advisable to begin with small doses and to increase them gradually according to the toleration of the patient.

Vaccine therapy is at times beneficial, many kinds having been injected. There is no uniformity of opinion regarding the stage of the disease favorable for this therapeutic method, which kind is best, or the results obtained. The benefits are temporary and apparently due in a large measure to a nonspecific protein reaction provoked by the vaccine injections. Protein shock produced in various ways has been occasionally effectual.

Local Remedies.—Various local treatments are now and then employed, but they have no curative effect upon the general disease. Carbon dioxide snow is a favorite agent used on cutaneous lesions. Ultraviolet rays, in the experience of Cruz, have given negative results on leprotic skin lesions except on those which were ulcerated. Ulcerations exposed directly to ultraviolet rays improved, with the exception of such ulcers as were due to trophic disturbances in which the blood supply was poor, and there was considerable sclerosis. Unna has recommended ultraviolet light for leprous conjunctivitis and iritis. Roentgen therapy has caused so little improvement that it is not recommended.

Chemical caustics may eradicate nodules and thus increase the comfort of the patient.

Recurrences.—Relapses are less frequent than formerly, but even with the intensive methods now employed they are not rare. Clinical features suggesting reactivation are numerous. A reddening or infiltration of the sites of former lesions is the commonest manifestation and less often new spots appear on previously unaffected areas. Enlargement or tenderness of the superficial lymph glands and nerves is occasionally noticed. Many of the relapses are not associated with clinical manifestations. Wade and Lara report that of 508 persons on the negative list at Culion Leper Colony, from 1922 to October 15, 1925, 75 (15 per cent) had suffered interruption because later they were found bacteriologically positive. Of 64 of these, 55 per cent showed no clinical evidence of reactivation.

RHINOSCLEROMA

Synonym.—Nasal scleroma.

Rhinoscleroma is a chronic sclerosing inflammatory disease of the nose and adjacent parts, which is rare in the United States, but is endemic in Austria, Galicia, and Southern Russia, and is encountered occasionally in Brazil, Argentina, Chile, Spain, Italy, and Sweden. It is presumably caused by a short rodlike encapsulated bacillus which is invariably present in this disease and in no other and is pathogenic to some rodents. The Bacillus rhinoscleromatis of von Fritsch is easily demonstrated in smears prepared from serum obtained by incising and squeezing the surface of a nodule. It is cultivated without difficulty on ordinary media where it forms gelatinous colonies. The bacilli are gram-negative and closely resemble the pneumobacillus of Friedländer.

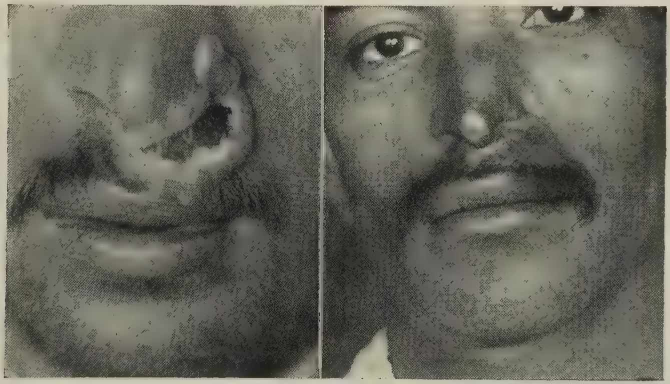

Fig. 520. Fig. 521.

Figs. 520, 521.—Rhinoscleroma. Before and after x-ray treatment. (Courtesy of Dr. Harry E. Alderson.)

The disease begins insidiously and produces a nodular or rather diffuse sclerotic enlargement of the nose, upper lip, palate, or neighboring structures. The nodules at first are small, hard, subepidermal and freely movable, but fuse to form sclerotic plaques which are adherent to underlying parts. Ulceration does not occur. The lesions have a distinctive stony hardness, are quite insensitive, and are of dusky purple or ivory color. The hairs disappear from the skin over the lesions. In the more advanced stages of rhinoscleroma the cartilaginous growth produces extensive mutilation of the appearance together with complete obstruction of the nares, superficial breaking down and seropurulent exudation. In the course of many years, a cicatricial shrinkage occurs and there may be an extension to the maxillary bones.

Histologically, there is a distinctive, deeply situated, dense, cellular infiltration composed chiefly of plasma cells and large degenerated cells (Mikulicz cells) which contain clumps of bacilli.

Rhinoscleroma has such distinctive features that its diagnosis is not difficult. It might be confused with giant-cell sarcoma or gumma, but can be easily identified by demonstration of the causative bacillus.

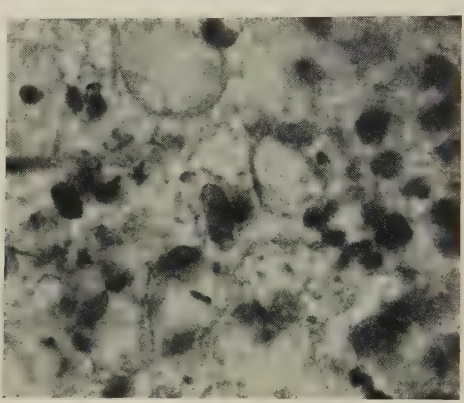

Fig. 522.—Rhinoscleroma, showing plasma cells and the large vacuolated cells of Mikulicz. The nuclei of these are eccentric, and in the cytoplasm bacilli can be seen. (Courtesy of Dr. Frederick A. Figi and Dr. L. Thompson, Mayo Clinic.)

Rhinoscleroma is recalcitrant to any therapeutic measure but by far the best results are obtained by radiotherapy, either with high voltage *x*-rays, or gamma rays from radium. Cross-firing from tubes within the nose and external trays or interstitial platinum implants is advisable. Simultaneous administration of large doses of potassium iodide may enhance the benefits of the irradiation.

DIPHTHERIA OF THE SKIN

Infection of the skin by the Klebs-Loeffler bacillus may occur secondarily in wounds, or primarily, in which case a variety of lesions may follow. The

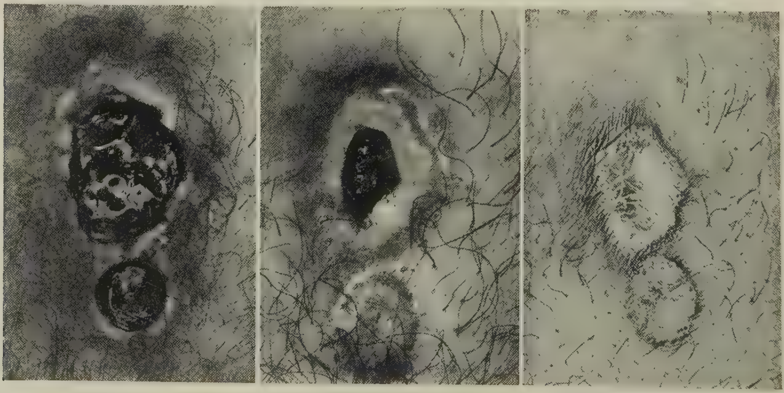

Fig. 523. Fig. 524. Fig. 525.

Figs. 523–525.—Diphtheritic ulceration of the skin, showing the effects of treatment by an injection of diphtheria antitoxin. (Courtesy of Dr. Hamnett A. Dixon.)

Fig. 523.—Before treatment.

Fig. 524.—Four days after injection.

Fig. 525.—Healed.

most widely known form of cutaneous involvement is the production of a false membrane and gray ulcerations about the swollen edges of a wound, usually with a fatal outcome. Less known but more interesting is a variety of other skin conditions which have yielded positive cultures of the Bacillus diphtheriae—eczematous, impetiginous, vesicular, pustular, and bullous eruptions, ulcerations and gangrene, with various degrees of constitutional disturbance. Skin involvement may occur independent of, or associated with, infection of the mucous membranes. Craig reported what was probably an ulcerative type of diphtheria of the skin in the British army in Africa under the term "desert sore."

Quarantine is necessary. Active treatment is by the subcutaneous injection of diphtheria antitoxin near the lesion, which has a pronounced beneficial action. Local dressings with antitoxin are also made. Treatment should be energetic as the disease is frequently fatal.

NECROBACILLOSIS

Necrobacillosis of the skin is a rare infectious disease due to the Bacillus necrophorus of Dammann. It has been described by Stemen and Shaw. Their case occurred in a government meat inspector who developed bullous lesions upon a small scratch wound on the hand. The infection was accompanied by high temperature, prostration, and intense swelling of the hand and arm, which subsided after a week of local treatment by drainage and wet dressings. Pure cultures of Dammann's bacillus were recovered from the bullae.

ERYSIPELOID (ROSENBACH)

Erysipeloid is an erythematous burning swelling of the hands without constitutional symptoms. It originates from decomposing animal matter.

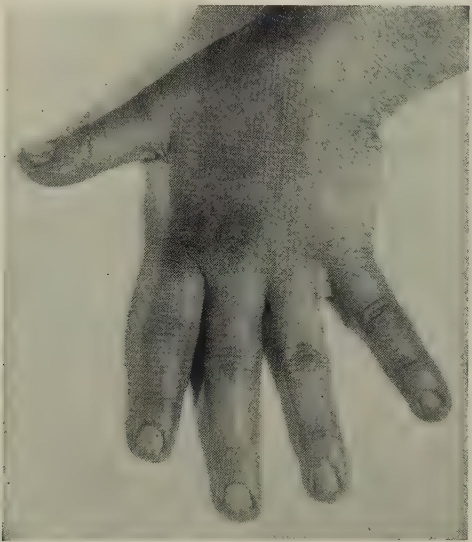

Fig. 526.—Erysipeloid, duration two weeks. First two fingers were swollen and bluish red, and there was a patch of the same color at the base of these fingers. Onset accompanied by throbbing pain and stiffness, occurring two days after hunting coon. Hand was bruised upon a rock and then patient carried home the live coon by wrapping its tail around the two involved fingers. (Courtesy of Dr. Joseph V. Klauder.)

The affection resembles a mild attack of erysipelas, beginning as an erythematous spot usually on a finger, spreading slowly with a well-defined erythematous margin, intense swelling, and tension of the skin, and clearing up in a few weeks. Gilchrist traced all but 6 of 329 cases to crabs, the infective agent probably being transmitted by their claws from putrid animal matter upon which they had fed. He was unable to isolate the organism. In many cases erysipeloid is apparently caused by the erysipelothrix of swine erysipelas, a rod-shaped, nonmotile, gram-positive organism which tends to form long branching filaments. Treatment is by wet dressings of antiseptic solutions, such as neutral acriflavine, 1 : 1000 in physiologic saline, or bichloride of mercury, 1 : 2000 in 50 per cent alcohol. Ultraviolet light is said to be beneficial.

GLANDERS

Synonyms.—Equinia, farcy, malleus.

Glanders is a rare, usually fatal, infectious disease which occurs in man by inoculation with Bacillus mallei and is encountered in those who handle horses and cattle. The disease is seen in two forms, the acute and the chronic, both of which are characterized by fever, glandular enlargement, cutaneous lesions, and inflammation of the respiratory tract.

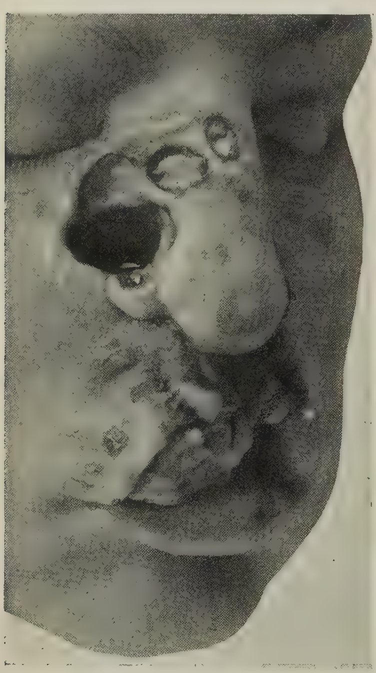

Fig. 527.—Human glanders. Duration, four months. Note carbuncular lesion on upper lip and farcy buds. Patient was a groom. (Courtesy of Army Medical Museum.)

The distinctive skin lesion is an inflammatory papule or vesicle which arises at the site of inoculation, rapidly becomes nodular, pustular, and ulcerative, and forms an irregular excavation with undermined edges and a base covered with a purulent and sanguineous exudate. In the course of a few days or weeks other nodules (called "farcy buds") develop along the lymphatics in the adjacent skin or subcutaneous tissues; subsequently these break down. Extensive cutaneous areas may be affected with confluent ulcerating and sloughing lesions. In the acute form the skin involvement may be severe and accompanied by grave intestinal disorder. In the chronic form there are few skin lesions and milder constitutional symptoms, but death is likely to ensue from nephritis, intercurrent infection, or exhaustion.

The respiratory mucous membranes are specially susceptible to the disease. At first catarrhal symptoms are present and there may be epistaxis or a mucoid nasal discharge. Later ulceration develops, and there may be extensive sloughing and a profuse purulent secretion containing numberless bacilli. The nasal discharge is a characteristic feature of the disease.

Treatment is chiefly symptomatic, being both medical and surgical. Immediate removal of the inoculated lesions by excision or by curetting offers the only chance of saving the patient in the acute type. Injections of antitoxin (mallein, 1 to 2 cc.) have had considerable value in some chronic cases and should be tried.

TULAREMIA

Synonyms.—Ohara's disease, deer fly fever.

Tularemia is a febrile disease produced by inoculation of the Bacterium tularense in man by a variety of wild animals and insects which harbor the organism. The most frequent sources of human infection are from handling wild rabbits, or from the bite of deer flies or ticks, the micro-organisms being transmitted through the eggs of ticks from one generation to another. No instance of the spread of the infection from man to man by contact has been reported and it is apparently noncontagious. Outbreaks of the disease occur chiefly at those times of the year when contact with certain sources of infection is most likely.

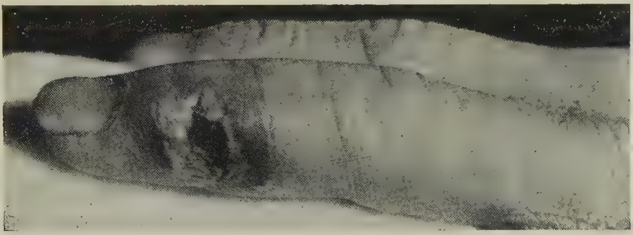

Fig. 528.—Ulcer of finger nineteen days after onset in a market man who dressed rabbits. (Courtesy of Drs. Grafton T. Brown and Oscar B. Hunter.)

Bacterium tularense is a short, nonmotile, gram-negative, rod-shaped or coccoid organism that appears encapsulated in tissues prepared with Giemsa's stain.

The disease occurs chiefly in the western and southern United States, although cases have been reported in Japan and in almost all parts of this country. The occurrence of the primary lesion of tularemia at the point of inoculation on the skin, and the associated cutaneous eruptions make its recognition by dermatologists a matter of importance. The disease is characterized by sudden onset, with chills, headache and leukocytosis, after an incubation period of two to seven days, and its clinical course is divided into two general types—the ulceroglandular and the typhoid.

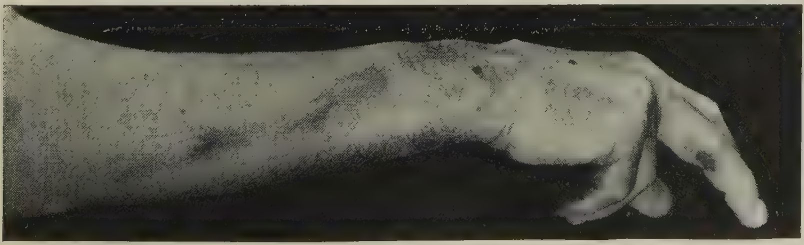

Fig. 529.—Tularemia resembling sporotrichosis. (Courtesy of Drs. J. B. and Bedford Shelmire.)

The ulceroglandular type begins with a primary papule or nodule which rapidly ulcerates at the site of infection, usually on the fingers, neck, or conjunctiva, frequently in an abrasion or scratch. The primary lesion is tender, firm and indolent, with a necrotic base, which after separating leaves a punched out ulcer about 1 cm. in diameter that heals with scar formation in about six weeks. A lymphangitis spreads from the primary lesion; the regional lymphatic glands become swollen and inflamed, and tend to break down, forming subcutaneous suppurative nodules resembling those of sporotrichosis. Before suppuration the nodules are firm and movable, extending in a chain from the ulcer to the enlarged lymphatic glands. When the primary lesion is on the fingers, the enlargement of the axillary glands may simulate tuberculous adenitis, being slightly tender on pressure and continuing a long time. The ulcer is differentiated from the syphilitic chancre by its punched-out appearance, the inflammation around it, the lack of induration, the central necrosis, and by the presence of burning and pain. The clinical similarity of the primary ulcer of tularemia to a lesion of sporotrichosis is important in differential diagnosis.

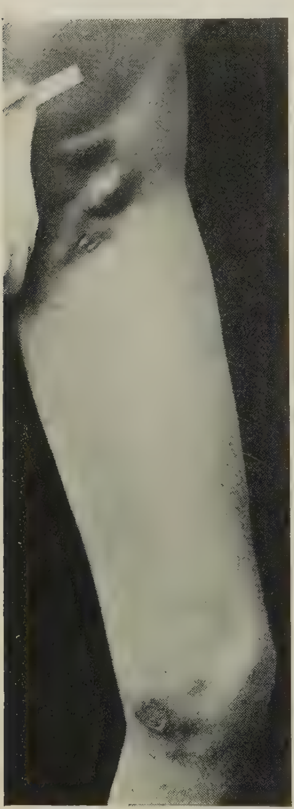

Fig. 530.—Tularemia following tick bite of left knee. Note enlargement of left inguinal glands. (Courtesy of Thomas B. Magath and Wallace M. Yater.)

Other skin lesions are encountered in the course of the disease which are in no way characteristic and are probably of a toxic nature. Herpetic lesions,[1] erythema-multiforme-like eruptions, and localized pustular manifestations have been reported. In 32 out of 614 cases of tularemia Francis observed a bilateral eruption on the upper trunk, arms, and face during the first week, usually of a blotchy, macular, or papular type. The course of the ulceroglandular type is marked in the early stages by headache, anorexia, vomiting, and by articular and muscular pains. The fever is at first continuous, varying between 102 and 104 F. and later shows morning remissions, and then falls by lysis to normal.

In the typhoid type the site of inoculation is not known and there is no local sore or adenopathy. This form of the disease is characterized by persistent fever, malaise, and gastro-intestinal symptoms and the presence of specific agglutinins in the blood serum after the first week. The Widal test is negative. Animal inoculation with infected material will cause death in about a week. However, Francis has shown that the agglutination test is the only reliable and practical means of laboratory diagnosis. Blood cultures and direct smears are not successful and animal inoculation is undesirable because of its slowness and the frequency of infection in laboratory workers. Agglutination tests, however, should not be performed before the second week.

In addition to these two types, Francis recognized two others. One of these is the oculoglandular type, in which the primary lesion is a conjunctivitis and is accompanied by enlargement of the regional lymph nodes. The other is called the glandular type. In it there is no primary lesion at the site of infection, but there is enlargement of the regional lymph glands.

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[1] Francis, E.: Oxford Medicine, New York, Oxford University Press, 1926, p. 955.

Convalescence from the disease is slow, requiring three months or longer before patients can return to work. According to Francis, relapses of fever have occurred as late as eight and ten months afterward, and suppuration of the lymph glands has been recorded even one to two years after the onset of the disease. Recovery usually takes place without evident sequelae. In the fatal cases, death generally ensues two to five weeks after the date of infection, the immediate causes being bronchopneumonia, nephritis, or peritonitis.

According to Permar and Weil, the histopathology of tularemia is that of a granuloma; the tissue reaction consists primarily of a massing of endothelial cells and the formation of giant cells. There is then a hyperplasia of the endothelial cells, which results in obliteration of the capillaries. After this, necrosis supervenes and there is liquefaction accompanied by polymorphonuclear leukocytic infiltration. Small secondary lesions may develop and these pass through the same stages and tend to fuse with the primary one. The process of healing is slow, being effected by organization.

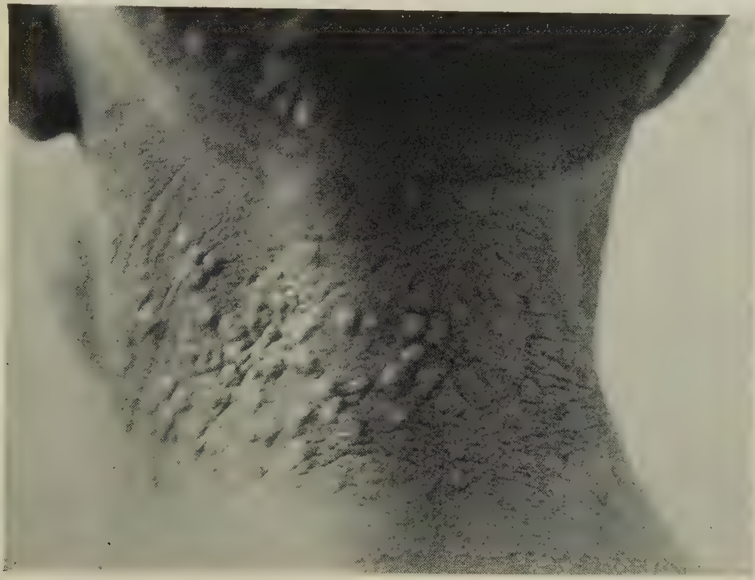

Fig. 531.—Tularemia. Papular eruption on posterior surface of neck. Three weeks after onset of illness. (Courtesy of Dr. W. M. Simpson.)

All market men, hunters, cooks, and others who dress rabbits should wear rubber gloves when doing so. Thorough cooking destroys the infection in a rabbit, thus rendering an infected animal harmless for food.

Symptomatic medical and surgical measures are invoked, as no specific treatment is known. Suppurative glands are incised and drained. Wet dressings are employed over the local lesions. Arsphenamine and mercurochrome–220 soluble have been injected intravenously, and vaccines and serums have been given, but without definite benefit. Quinine and coal tar antipyretics have also been used.

ANTHRAX

Synonym.—Malignant pustule.

Anthrax is an acute infectious, generally fatal disease which begins with a rapidly necrosing carbuncular lesion and suppurative adenitis, and in its course develops metastatic abscesses, and constitutional symptoms, which are usually grave. The disease is produced by the Bacillus anthracis, a large rod-shaped, gram-positive organism which occurs singly or in pairs in smears from the blood or in material from the local lesion, or in long chains on artificial media where it tends to form spores. Human infection generally results from the handling of hides or other animal products from stock which has died from splenic fever. Cattlemen, woolsorters, tanners, and butchers are most liable to infection. A number of cases of infection from the use of cheap pony-hair shaving brushes have been reported.

The first clinical manifestation is an inflammatory papule, which begins a few hours or days after infection. The inflammation rapidly develops so that there is a bulla surrounded by intense edema and infiltration. Within a short time it ruptures spontaneously, the contents being purulent or sanguineous. A dark brown eschar is then visible surrounded by vesicles and pustules situated upon a red, hot, swollen, and indurated area. The regional lymph glands become enlarged and frequently suppurate. In severe cases the inflammatory signs increase, there is extensive edematous swelling, other bullae and necrotic lesions develop, accompanied by a high temperature and prostration, terminating in death in a few days or weeks. In mild cases the constitutional symptoms are sometimes slight; the gangrenous skin sloughs, and the resulting ulcer heals.

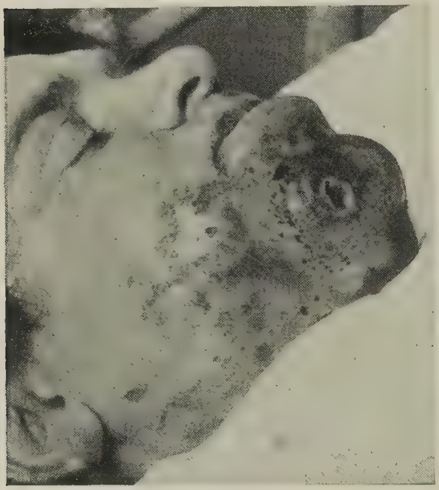

Fig. 532.—Anthrax. Note carbuncular lesion undergoing central necrosis, and the enlargement of the submaxillary glands. (Courtesy of New York City Department of Health.)

Diagnosis is made by the demonstration of the causative agent in smears of local material. The characteristic gangrenous lesion surrounded by vesiculation, intense swelling and redness, and the occupation of the victim are accessory factors. In taking the history it is important that the patient be questioned regarding the use of escharotics. Carbuncle, chancre, and a cauterized infected wound must be excluded from the diagnosis.

Immediate and wide surgical excision of the primary lesion must be made whenever possible; otherwise multiple incisions and antiseptic dressings, or applications of phenol or tincture of iodine are indicated. Anti-anthrax serum is also given without delay, with an initial dose of 100 cc. Hyman and Leary have substituted normal beef serum for anti-anthrax serum, believing the benefits of the latter are due to protein reaction rather than to constituent immune bodies, and they have had good results. Local injections of serum are recommended by Regan to supplement the other injections. Ormsby states that quinine and sodium hyposulphite are of value for systemic involvement.

CHANCROID

Chancroid is an infectious ulcerative, venereal disease due to the bacillus of Ducrey. The organism causes deep, tender, and usually multiple sores on the genitals, and suppurative inguinal adenitis, called buboes.

The disease begins as an inflammatory macule or pustule a few hours or days after sexual intercourse. It generally affects the prepuce, glans, or frenum in the male, or the labia minora, clitoris, fourchette or vestibule in the female. Neighboring parts may be involved through auto-inoculation. The pustule ruptures early, with the formation of a ragged ulcer which lacks the induration of a chancre, usually being soft with an indefinite inflammatory thickening. The ulcers may be multiple, as stated, and they often appear punched out, or have undermined irregular edges, surrounded by mild hyperemia. The base is covered with a purulent dirty exudate. Pain is a common symptom. The inguinal lymph glands after a few days are inflamed and rapidly suppurate, become fluctuant and break through the skin, sometimes with two or three fistulous openings. As a result of mixed infection phagedenic features may develop and cause extensive destruction. The duration varies from a few weeks to several months.

Diagnosis.—The diagnosis may be suspected from the clinical appearance, but is definitely established by demonstration of the bacillus of Ducrey, which may be done by smears or cultures. In fresh specimens the organism is a short bacillus with rounded ends, often occurring in chains. In cultures it is frequently longer and the chains are more pronounced, so that it resembles Bacillus subtilis.

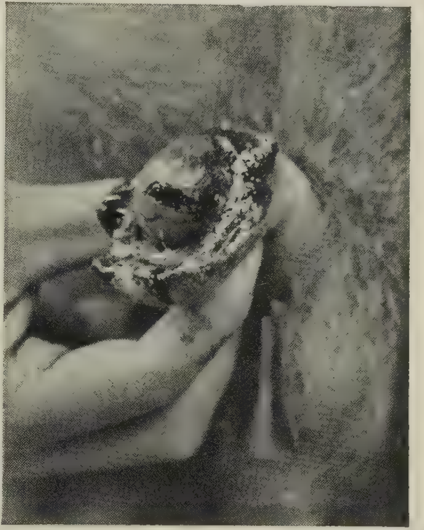
Fig. 533.—Chancroid. (Courtesy of Dr. A. Benson Cannon.)

Ordinary methods of culture are unsuccessful. Teague and Deibert recommend the following: Two parts of liquefied agar at 50 C. are mixed with one part human, dog, or rabbit blood. The blood from the cut carotid of a rabbit may be allowed to run directly into the agar tube, to which the pus from the ulcerated bubo is then added in proper proportion, and the whole placed in the incubator at 35 C. They have reported good results with clotted rabbit's blood heated at 55 C. for fifteen minutes. Cultures grown in it for twenty-four hours at 37 C. may then be kept alive in the refrigerator for from three to five weeks.

The clinical features which differentiate chancroid from chancre are given on page 667. In mixed sores both diseases are present, a not infrequent occurrence. Chancroid may also be confused with granuloma inguinale, herpes progenitalis, and lesions due to phenolphthalein and other drugs.

Treatment.—Local cleanliness and dryness are the chief prerequisites of treatment. Cleanliness is obtained by irrigating the ulcerated surface with dilute solution of hydrogen peroxide every few hours, after which the surface is dried by pledgets of absorbent cotton, and covered with an antiseptic dusting powder, such as iodoform, bismuth formic iodide, or crystals of argyrol. Most cases respond to such treatment, but in those which do not, other measures must be invoked. Moist dressings of bichloride of mercury, 1 : 2000 solution, or neutral acriflavine, 1 : 1000 solution, are beneficial. Rupel recommends local applications of 0.5 per cent solution of antimony and potassium tartrate twice daily. Recalcitrant lesions are best cauterized with copper sulphate or nitric acid, novocaine being used for local anesthesia. Ultraviolet light and roentgen-ray therapy have occasionally seemed to expedite the healing.

In addition to the local treatment, the intravenous use of a 1 per cent solution of antimony and potassium tartrate in saline solution accelerates a cure. The initial dose is 3 cc., which is increased 1 cc. with each dose up to 10 cc., injections being given at intervals of four days. Mild reactions consisting of coughing, salivation, and vomiting occur in some cases, but disappear in a few hours. Jones, in an analysis of 27 cases treated in this manner, found the period of convalescence reduced at least 50 per cent.

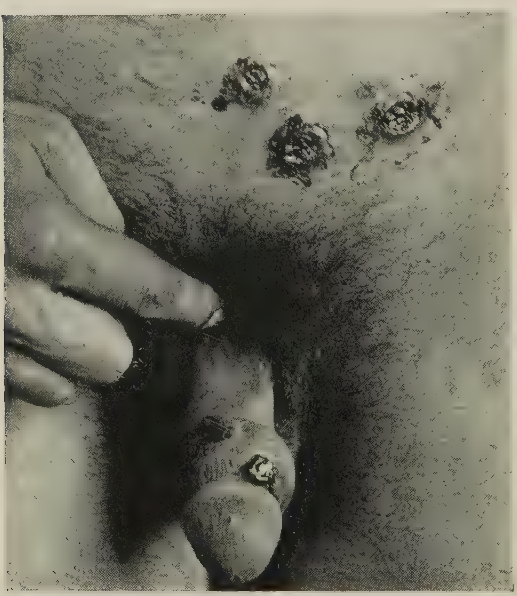

Fig. 534.—Chancroid. (Courtesy of Dr. Mihran B. Parounagian.)

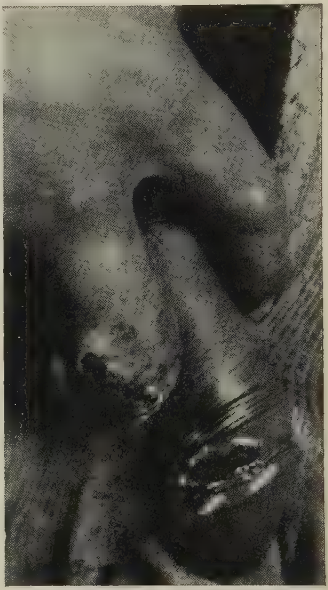

Fig. 535.—Chancroid of penis with lesion on knuckle produced by auto-inoculation. (Courtesy of Dr. Mihran B. Parounagian.)

ULCUS ACUTUM VULVAE

In 1904 Lipschütz described acute vulvar ulcer and differentiated it as an entity from similar conditions. Since that time about 50 cases have been reported. The condition is a rapidly progressive, painful, benign ulceration of the vulva, which simulates some venereal disease or phagedena.

Lipschütz distinguishes three clinical types:

1. **Gangrenous Acute Vulvar Ulcer.**—The sudden onset of this type is accompanied by fever and rigor, vivid burning pains of the external genitals, and edema of the labia. There is progressive ulceration during forty-eight hours, with involvement of the deeper tissue layers. The three stages of development are: (*a*) Formation of a firmly adherent dark

grayish-yellow or bluish-black scab; (*b*) shedding of the scab and formation of a delicate fibrinous grayish-yellow layer; (*c*) shedding of this layer, leaving the fundus of the ulcer bright red before rapid epithelization sets in. Fever and pain usually subside after shedding of the scab and complete recovery ensues in a little over two weeks.

2. **Pseudovenereal Vulvar Ulcer.**—This local process generally involves the vaginal vestibule, the skin of the labia majora and minora. The lesions simulate venereal ulcers. They are shallow or deep, round, oval or irregular; they range in size from a lentil to a nickel. They are sharply delimited and have a soft grayish-white base, which is often covered with some pus and is painful to the touch. The course of this disease is subacute or gradual, and because of newly recurrent ulcers it may be protracted over a month.

3. **Miliary Acute Vulvar Ulcer.**—This type is never observed by itself but is always associated with the pseudovenereal type. The lesions are not larger than a pinhead, are surrounded by a red areola and covered with a little pus; the center is slightly depressed. They are painful to the touch, like the miliary venereal ulcer which they simulate. This type usually involves the margins of the labia majora and subsides after a few days.

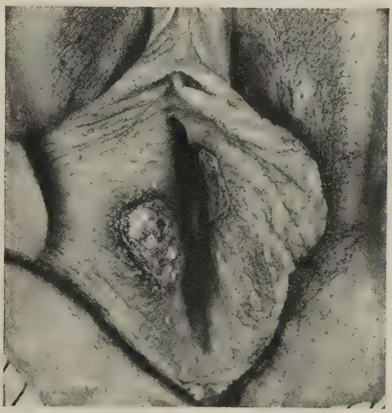

Fig. 536.—Ulcus acutum vulvae. (Courtesy of Dr. Clark W. Finnerud.)

The lesions usually involve the inner surfaces of the labia minora. Other areas affected in the order of frequency are: Margins of labia minora and majora; interlabial fold; introitus vaginae; hymenal fold; fossa navicularis; perineum; anterior and posterior commissures; prepuce of clitoris, and occasionally the genitocrural fold. These lesions occur either as numerous ulcers of different sizes, or as a few large well-developed ulcers. They may be strictly circumscribed or tend to coalesce. Occasionally, the inguinal glands are slightly enlarged.

The disease affects chiefly girls between the ages of fourteen and twenty; but at times pluriparae. There is a tendency to recurrence. Six recurrences in one case were reported by Lipschütz. That it is not contagious is proved by the failure of positive auto-inoculation experiments. The similarity of the disease to aphthous stomatitis has been noted. Microscopical examination of smears from the ulcers invariably shows the presence of bulky, gram-positive rods called Bacillus crassus, which is considered by some to be identical with Döderlein's bacillus. a common saprophyte of the genital tract. It is possible that this bacillus may become pathogenic or that some undetermined virus is of prime etiologic importance.

With respect to *differential diagnosis*, Lipschütz states that acute vulvar ulcer is more benign and heals more quickly than gangrenous genital ulcers, and lacks the putrid odor. It may be differentiated from venereal ulcer by the bright red base below the fibrinous layer and by its tendency to spontaneous and rapid healing. Other ulcerative processes due to acute and chronic infections or to mixed infections present little difficulty in differential diagnosis, since their symptomatology and clinical course differ from those of the lesion described.

Prognosis is, on the whole, favorable, but, as stated, there is a tendency to recurrence. The lesions heal spontaneously or from hygienic treatment. Lipschütz reports that autogenous vaccine was beneficial in one recurrent case, although after the cure the vaginal secretion still contained Bacillus crassus.

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CHAPTER XXV

SYPHILIS

Synonyms.—Lues, lues venerea, pox.

Causative Agent.—Syphilis is an infectious, chronic, constitutional disease, which may be inherited, although it is usually acquired through promiscuous sexual intercourse or other contacts. It is caused by the Treponema pallidum, also known as Spironema pallidum, and Spirochaeta pallida. Infection enters through the skin or mucous membranes, on which the most characteristic manifestations are also observed, and for these reasons the diagnosis and treatment of syphilis are an important part of dermatology.

The Treponema pallidum was discovered by Schaudinn and Hoffmann in 1905. It is a delicate spiral parasite which is actively motile. The number of spirals varies from six to twenty-four and the entire length is about seven microns. The motility is characteristic and consists of three movements; a projection in the direction of the long axis, a rotation of the spiral on its long axis, and a bending or twisting from side to side. The activity of the living organism varies considerably in different preparations, and it gradually disappears in old specimens.

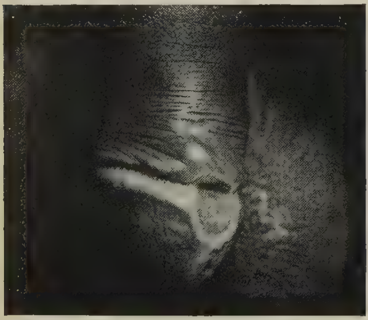

Fig. 537.—Chancre of frenum. (Courtesy of Dr. Mihran B. Parounagian.)

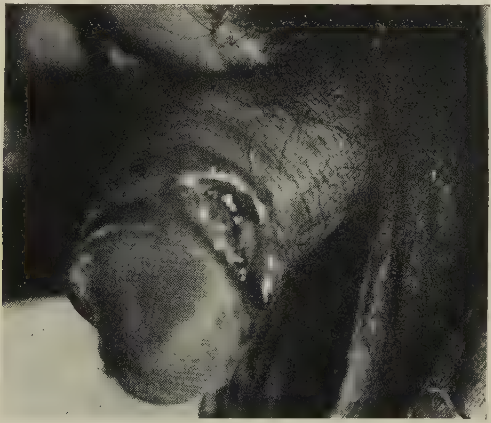

Fig. 538.—Hunterian chancre at the sulcus.

Invasion.—The invasion after inoculation is apparently rapid. Kolle and Evers, in experimentally infected rabbits, found the inguinal lymph nodes infectious a few hours after scarification and inoculation into the skin. Such experimental conditions may not apply to human beings. Arzt and Kerl found the blood of patients with chancres and negative Wassermann reactions infectious twenty-one or possibly fourteen days after they had acquired the disease. Although abrasion favors infection, the organism apparently may gain entrance through healthy skin or mucous membrane. The first cutaneous manifestation of the disease is a sore called the chancre, at the site of entry. Prior to its appearance constitutional symptoms such as headache, pallor, and anorexia are often present, and involvement of the nervous system and parenchymatous structures may occur.

Tissue Reaction.—The tissue reaction to the invasion is largely local both at the site of inoculation and in various parts of the body where the parasite lodges. The inflammatory process is characteristic in all regions, being chiefly an accumulation of lymphocytes, plasma cells, large mononuclear cells, and fibroblasts; and the formation of many new blood vessels. The infiltrating cells are collected mainly about the blood vessels, the walls of which are thickened. The intima is principally affected, due to a swelling and a proliferation of the endothelium, which may lead to obstruction of the lumen.

Cycles.—After invasion, the organisms increase rapidly in number and escape from the lymphatic channels which drain the point of entry into the blood stream. They continue to reproduce until a time when the tissue defense reaction is powerful enough to destroy or inhibit them. Then local healing ensues, but after a time the body defenses lose their restraining powers and the organisms again increase in number. These cycles of proliferation of spirochetes, suppression by the tissue reaction, decline of the defensive forces, and relapse of morbid activity occur endlessly throughout the course of the disease. Local healing is thus not a proof of cure, and the tendency of syphilis is toward innumerable relapses during which at any time and in any organ the pathologic process has the fundamental characteristics previously mentioned.

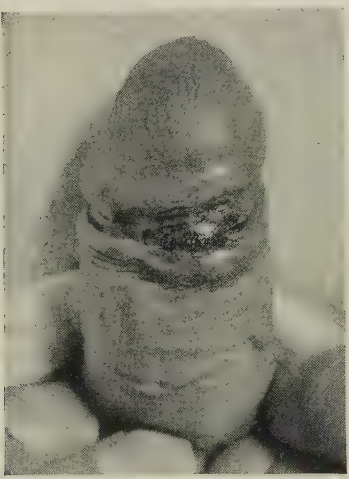
Fig. 539.—Chancre of sulcus.

Stages in the Disease.—Before laboratory findings showed the rapid generalization of the infection and the presence of organisms in late lesions of the disease, it was customary to divide the course of syphilis into three stages—primary, secondary, and tertiary. These terms are still in common usage, but less so than formerly. The primary stage is characterized by the presence of the chancre or the initial lesion. Due to dissemination of the organisms a more or less generalized eruption accompanied by lesions of the mucous membranes and by constitutional symptoms makes its appearance usually three to six weeks after beginning of the chancre. The stage of these early generalized manifestations is called the secondary period. The late localized manifestations, of which the gumma forms the typical lesion, are features of the so-called tertiary period. In the light of modern knowledge, these divisions are somewhat misleading, for the disease is not localized during the so-called primary stage or even during the incubation period, prior to the appearance of the chancre. The primary and secondary stages so merge into one another that the differentiation is more a matter of personal opinion than of scientific demonstration. The division between the secondary and tertiary periods, which has always been obscure, has become increasingly confusing since the use of salvarsan. Recrudescence of secondary eruptions may occur in the late stages of syphilis, and sometimes localized gummatous processes are observed early in the course of the disease, the character of the pathologic response depending somewhat upon the allergic state of the patient. There is no sharp line of demarcation between any of the stages clinically or immunologically. Kolmer adopts the classification of early and late syphilis according to the pathology, for chemotherapeutic reasons. "The stage of early syphilis is one in which none of the lesions is fibrotic and in which vascular occlusion has not occurred; hence, chemotherapy may effectually destroy all of the spirochetes. The stage of late syphilis embraces the clinical tertiary stage in which many of the lesions are fibrotic and probably beyond the possibility of cure in the sense of destruction of the parasites and absorption of the inflammatory tissue; on the other hand, however, younger lesions may likewise develop at this time, and these are vulnerable to therapeutic measures before advanced fibrosis and endarteritis have occurred."

SYPHILIS OF THE SKIN

CHANCRE

The chancre is usually the first cutaneous lesion, appearing after an interval of about three and one half weeks following infection. This period is rather indefinite, but the evolution is at any rate prolonged. Positive identification of the nature of the lesion is by microscopical examination of its fluid content, a dark-field condenser being used. Certain leading clinical characteristics of the chancre are valuable as corroboratory evidence. The typical incipient chancre is a small red papule or a crusted superficial erosion, which in the course of a few weeks becomes round or oblong, decidedly indurated, with an ulcerated surface that is raw and exudes a serous fluid. Chancres generally occur singly, although they are frequently multiple, and they vary in diameter, from a few millimeters to several centimeters, and in depth, being sometimes superficial and at other times deep. In women, the genital chancre is seldom observed, due to its location within the vagina or on the cervix, and when found is generally a small abrasion or an extensive edema of the labium or cervix. In men, the chancre is common in the coronal sulcus or on either side of the frenum. A lesion at the frenum is almost invariably a chancre. The typical Hunterian chancre, which is seen most frequently in these locations, is a rounded, superficially ulcerated, deeply indurated, slightly raised growth, a centimeter or so in width and a few millimeters in thickness.

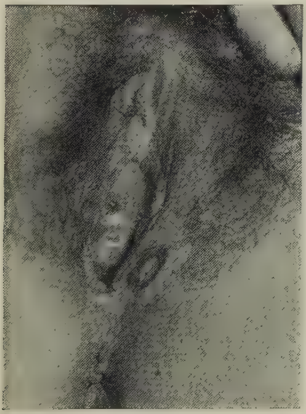

Fig. 540.—Chancre of fourchette.

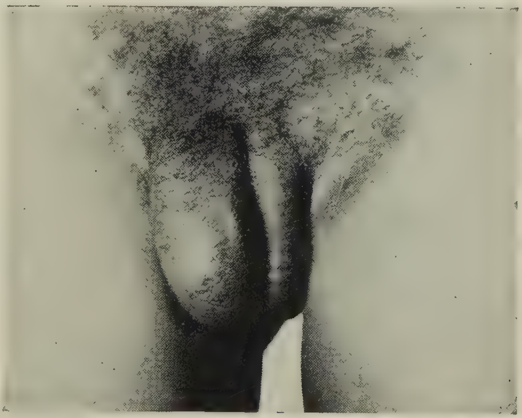

Fig. 541.—Chancre of labium minus, with marked edema.

The neighboring glands are usually enlarged, hard, and painless, the enlargement as a rule beginning a week or two after the appearance of the chancre.

Intra-urethral primary lesions are not uncommon and must always be searched for in early secondary cases when the chancre is not discovered. Intra-urethral chancre generally causes a slight serosanguineous or purulent discharge seen at the meatus, and produces an induration that may be palpated through the shaft of the penis.

Extragenital Chancre.—Extragenital chancres are likely to be much larger than those on the genitals, their contours and dimensions being modified by their location. Cases of extragenital infection are estimated to be between 5 and 10 per cent. The most frequent location of extragenital primary lesions is on the lips, where the inoculation has taken place through kissing an infected individual or through contamination from instruments, drinking vessels, forks, spoons, and other articles. They rarely appear in other locations, the most important sites being the tonsil, female breast, index finger, and anus. When there is a florid secondary eruption, and no evidence of chancre, and the glands below Poupart's ligament are markedly enlarged, anal chancre should be strongly suspected, a point emphasized by Parounagian.

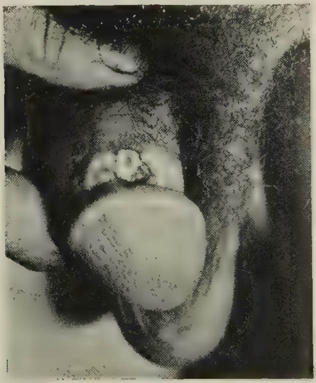
Fig. 542.—Chancre of sulcus.

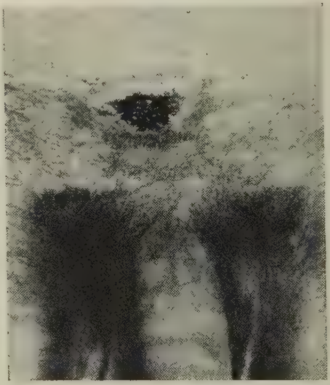
Fig. 543.—Chancre of pubes. (Courtesy of Dr Mihran B. Parounagian.)

Varieties of Primary Lesion, Chancre Redux, Syphilis d'Emblée.—Infection by the Ducrey bacillus and Treponema pallidum at the same time will produce a "mixed sore," which runs a course different from either chancroid or primary syphilis alone. Such a sore begins a few days after exposure, as the incubation period for chancroid is short, and later the sore becomes transformed into an indurated lesion due to a reaction of the connective tissue to the Treponema pallidum. In virulent types of the disease where the resistance of the individual is low, the syphilitic chancre and contaminating cocci may cause severe tissue destruction. Such lesions are called phagedenic. Multiple chancres are encountered fairly often, being from infection at several places during one or successive exposures or by auto-inoculation. Parounagian exhibited a patient with fifteen primary lesions. Due to insufficient treatment the chancre, after partial disappearance, may relapse, accompanied by enlarged lymph nodes and the presence of numerous spirochetes at the site of recurrence; such reappearance is termed "monorecidive." Chancre redux is not a chancre at all, but is a gummatous lesion occurring at the site of a previous chancre. It is distinguished from relapsing chancre by the absence of satellite glands and by a negative dark-field examination. Syphilis may begin without a chancre—syphilis d'emblée. Such cases usually arise from puncture wounds; one case I saw followed a blood transfusion, previous to which a Wassermann test upon the donor was omitted.

Diagnosis.—The diagnosis of primary syphilis is made by dark-field examination, as already stated. The local induration, and the enlargement and hardness of the inguinal glands are usually sufficiently characteristic so that those with experience may draw a reliable conclusion as to the diagnosis from the morphology of the lesion; but such clinical evidence must never be accepted as conclusive. Initial lesions may assume infinite morphological variations from the typical Hunterian chancre, which makes it necessary to differentiate the initial lesion from chancroid, scabies, herpes progenitalis, traumatic ulcer, lichen planus, carcinoma, drug eruption, and gumma. At its first appearance the chancre may lack the characteristic sclerosis, but later it is more easily distinguished from other infections. In chancre the lesion is an indurated plaque, the hardness being best felt by picking up the lesion between the gloved thumb and index finger. In chancroid and herpes there is no induration. These lesions, as well as the chancre, may be either single or multiple. Too much attention has been given to the multiple number of the lesions of chancroid and the single nature of the chancre. However, the lesions of chancroid are more tender and exudative than the chancre, and those of herpes are a cluster of vesicles which rapidly become eroded and crusted. In scabies the lesions are multiple and associated with pruritic papules distributed in the usual sites of predilection; consequently no confusion should exist unless the two diseases are present. In herpes progenitalis the lesions are vesicles, generally in one or more groups, and these become rapidly eroded, so that they are punctate superficial ulcers surrounded by an inflammatory zone and accompanied by a burning sensation. Itching frequently precedes the onset of herpes. The glands are usually not enlarged in herpes unless the lesions are infected. Traumatic ulcer is, as a rule, in the nature of a painful fissure on the frenum and is accompanied by slight local swelling. In lichen planus the lesions are flat papules, sometimes arranged in rings, and of a violet color when the organ has been circumcised, but of a milky color

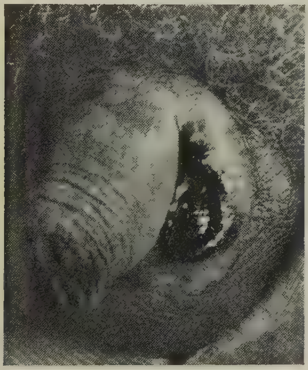

Fig. 544.—Scrotal chancre. (Courtesy of Dr. Mihran B. Parounagian.)

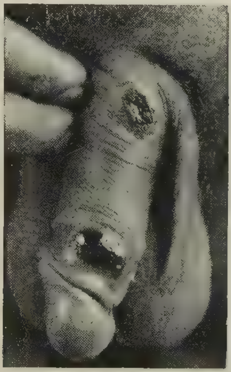

Fig. 545.—Multiple chancres of penis. (Courtesy of Dr. Mihran B. Parounagian.)

beneath the foreskin. Carcinoma of the penis is generally of the papillary type and occurs in those past middle life and in those who are not circumcised. It is of slow growth, usually arising on the dorsal aspect near the corona or on the prepuce. Hebrews are practically free from the disease. In the early stages it is a smooth thickening of the epithelium or a warty excrescence, which later becomes eroded and ulcerated. The inguinal glands are often involved. The glandular enlargement in syphilis is characteristic, being frequently bilateral, without tenderness, suppuration, or redness of the skin and accompanied in a few weeks by general adenopathy. In chancroid, the glandular enlargement is largely unilateral and the glands are tender, the overlying skin inflamed, and usually there are suppuration and the formation of a bubo. Chancre may be associated with a generalized eruption, a positive Wassermann reaction, and a positive dark-field examination, whereas these are lacking in chancroid and in herpes simplex. The causative organism of chancroid, the bacillus of Ducrey, may be demonstrated by smear or from cultures. The differentiation of chancre from epithelioma of the penis is made by the age of the patient, the duration of the lesion, and the tendency of epithelioma to affect the surface of the glans or the under surface of the foreskin instead of the frenum or coronal sulcus, which are the common sites for chancre. Epithelioma of the penis, as stated, forms an irregular tender ulceration which bleeds readily.

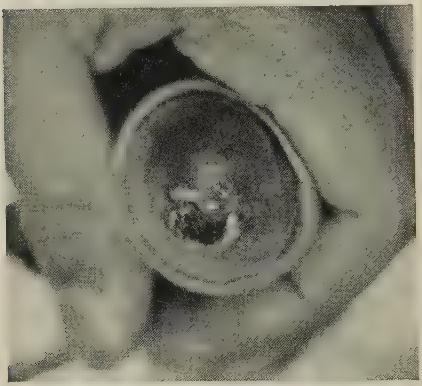

Fig. 546.—Meatal chancre.

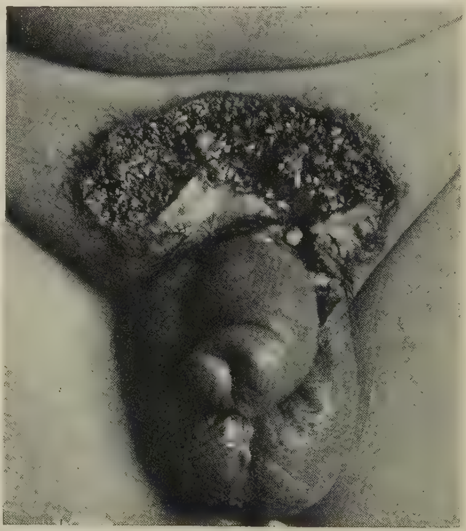

Fig. 547.—Phagedenic chancre. (Courtesy of Dr. Mihran B. Parounagian.)

Chancre of the lip is differentiated from carcinoma of the lip by its occurrence in younger adults without regard to sex, by its rapid growth, and early extensive enlargement of the submaxillary lymph glands. Carcinoma of the lip usually occurs in males over forty years of age and is a slowly growing induration of the lower lip which soon becomes ulcerated and bleeds easily. Neighboring glands enlarge only after several months and never attain nearly the size of those associated with chancre. The syphilitic lesion may be attended by a generalized eruption and identified by a positive dark-field examination, preferably of fluid obtained by puncture of the accompanying glands, and after a few weeks by a positive Wassermann reaction.

Disappearance of Chancre, and Signs of Generalization.—If left untreated, the chancre tends to disappear spontaneously after an interval of one to four months. About the time of its disappearance, or usually a little before, constitutional symptoms and objective signs of generalized syphilis occur, but these may be so slight that many patients pass through this important phase without the disease being detected. The skin manifestations of generalized syphilis are called syphilides.

The identification of generalized syphilis is largely made by the Wassermann test and the clinical recognition of the skin eruptions. The Wassermann test is positive in $98\frac{1}{2}$ per cent of untreated cases of secondary syphilis.[1] When the blood Wassermann reaction is negative, the dark-field examination of fluid expressed from the lesions is an important aid in the diagnosis, treponemata being found in serum from mucous membrane lesions, from skin lesions which have been intentionally abraded, or in the fluid obtained by gland puncture. The general ensemble of all symptoms must be considered. The final diagnosis rests with the laboratory, and when the tests are inconclusive they should be repeated until there is no doubt left.

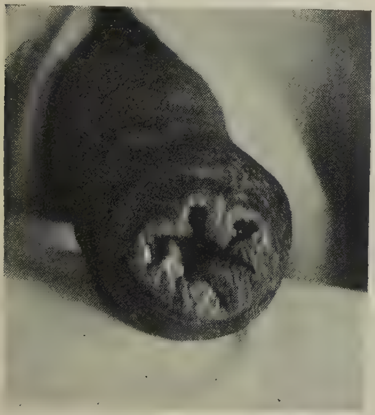

Fig. 548.—Rosette type of chancre. (Courtesy of Dr. Mihran B. Parounagian.)

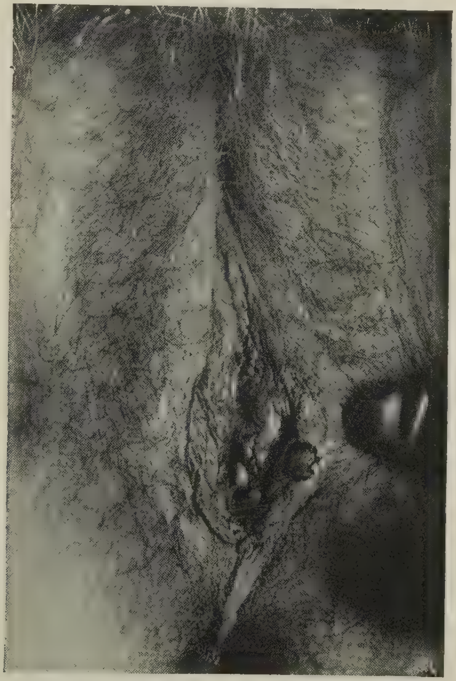

Fig. 549.—Chancre of vulva. (Courtesy of Dr. Mihran B. Parounagian.)

SYPHILIDES

The syphilides are, as a rule, divided into early, intermediary, and late. The early eruptions are symmetrical, more or less generalized, exanthematic, transient, macular roseolas, or maculopapular or papular eruptions, which are usually polymorphous, and grouped, and, less often, scaly, pustular, or pigmented. The early manifestations are apt to be distributed over the face, shoulders, flanks, palms and soles, and on the anal or genital regions. The severity varies widely in different cases.

The individual lesions are generally less than a centimeter in diameter, except in the later secondary eruptions, in relapsing secondary eruptions or in negroes. The macular lesions are characterized by a light pink color, which soon becomes brownish red, the tints being influenced by the amount of pigment and other qualities of the patient's skin. The color of the papular lesions has often been described as a "raw-ham color" or a coppery tint. In the presence of seborrhea it may be brighter red, but usually lacks the tints seen in acute inflammations and corresponds to the color of indolent lesions.

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[1] Stokes, J. H.: Modern Clinical Syphilology, Phila., W. B. Saunders Co., 1926, p. 431.

Early Syphilides.—*Macular Eruption.*—The syphilides begin insidiously with the appearance of an exanthematic roseola six to eight weeks after the development of the chancre, which may still be present or may have healed. In virulent infections or susceptible individuals this eruption may be noted earlier, while in instances in which desultory treatment has been given, it may appear later. The syphilitic exanthem extends rapidly, so that it is usually pronounced a few days after onset. It may be evanescent, lasting only a few hours or days, or it may last several months, or partially recur after having disappeared. As a rule, this earliest eruption is macular and appears first on the sides of the trunk, on the shoulders, and the inner surfaces of the extremities, and then involves the entire skin with the exception of the face and hands. The roseola consists of rounded indistinct macules which are never confluent and may rarely be slightly elevated or urticarial. As already mentioned, the color varies from a light pink, or old rose, to reddish brown. The macular eruption is seldom noticed in negroes, and is so faint that it is frequently not recognized in others, although it is the commonest of the syphilides. Special aids for the detection of these faint macular exanthems—as ultraviolet light—are often desirable. However, the lesions are sometimes conspicuous, forming eruptions so characteristic that diagnosis is self-evident to even the casual observer. Pain, burning, and itching are absent, but occasionally slight itching is said to be present, although no scratch marks are observed. Simultaneous with the onset of the roseola there are a generalized adenopathy most readily palpable in the posterior cervical, axillary, and epitrochlear areas, a pharyngitis, and headaches. In men a primary lesion is usually present.

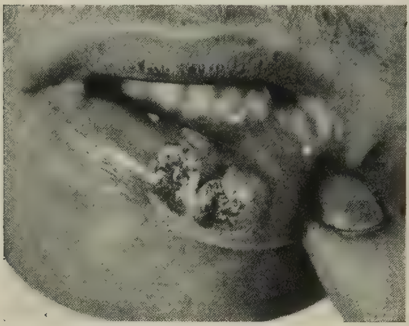

Fig. 550.—Chancre of lip.

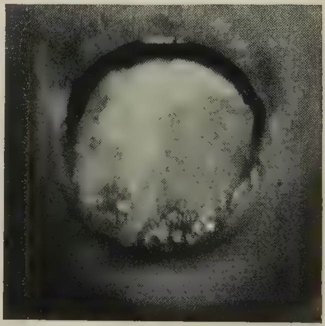

Fig. 551.—Chancres of tongue. (Courtesy of Drs. J. B. and Bedford Shelmire.)

The macular syphilide must be differentiated from toxic erythema, drug eruptions, pityriasis rosea, measles, and tinea versicolor. The syphilide is generalized, but affects chiefly the loins and inner aspects of the extremities, the face generally being exempt, whereas in toxic erythema, drug eruptions, and measles, the face is usually involved. In syphilis the macules are of uniform size, being as a rule less than 1 cm. in diameter, and are a faint, dull-red color with a tendency toward brownish tints. Accompanying the macular syphilide, there is likely to be general adenopathy, remains of the primary lesion, or other manifestations of syphilis, including a positive Wassermann reaction, whereas these are absent in the other diseases. In toxic eruptions the lesions are usually brighter in color, of irregular shape, large and urticarial, and are situated on the face, backs of the hands, and on the shins. In pityriasis rosea and tinea versicolor the eruption involves the trunk, upper arms and thighs, the face being exempt. The lesions of pityriasis rosea may be macules or maculopapules and form oval pink spots, more than a centimeter in their long diameter, which runs parallel with the ribs. The generalized eruption is preceded by a herald patch. The spots tend to clear up in the center where the epidermis becomes crinkled and light brown. Slight desquamation is present. In tinea versicolor the chest and upper back are favorite sites of involvement and the lesions are yellowish and brownish, finely scaling spots which fuse to form large patches. The Microsporon furfur may be demonstrated in the scales. The differentiation from measles is easy on account of the occurrence of distinctive conjunctivitis in this disease, inflammation of the upper respiratory tract, a temperature, and a tendency of the skin lesions to form crescentic groups so that the general appearance is blotchy. It is more difficult, however, to distinguish the macular syphiloderm from German measles; with both there may be a slight temperature and a marked adenopathy, especially of the postcervical glands, but in German measles the color of the eruption is a vivid pink.

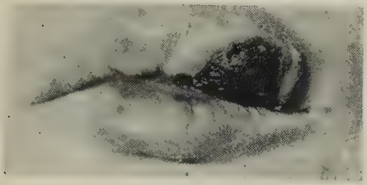

Fig. 552.—Chancre of upper lip.

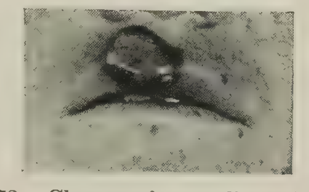

Fig. 553.—Chancre of upper lip. (Courtesy of Dr. Mihran B. Parounagian.)

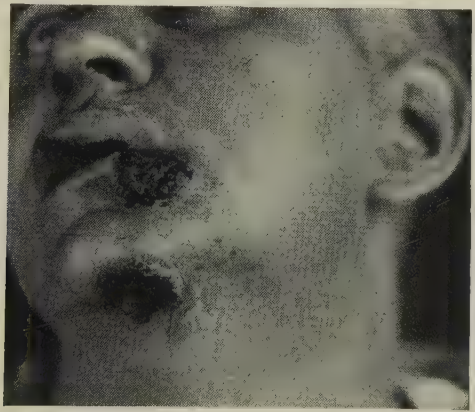

Fig. 554.—Multiple chancres of lips and chin. (Courtesy of Dr. Mihran B. Parounagian.)

The macular eruption may disappear spontaneously after a few days or weeks without any residuum, or may leave brownish stains or slight scaling in brunettes. After a varying interval the roseola may be followed by other eruptions, or it may progress immediately into other forms. In this event some of the macules become papules, the latter possibly predominating. Evolution of the eruptions subsequent to the initial exanthem is slow, and they are characterized by indolence, polymorphism, and grouping. One of the most distinctive and common forms is composed of a mixture of macules and papules.

Papular Syphilide.—Fully developed papular eruptions in syphilis are of a raw-ham or coppery shade, and the lesions are indurated and vary in both size and distribution. Three varieties occur in early syphilis: The small papular, the large papular, and the papulofollicular. The papules may be small (miliary) or large (lenticular or discoid), lichenoid, flat, and scaly, or acuminate. The small papular syphilide is usually profuse, and widely and symmetrically distributed, especially on the flanks and the extremities. The papules are of a dirty brownish-red color and are sometimes surrounded by a collarette of fine scales. The large papular syphilide has fewer lesions, which are distributed on the face or flexor surfaces of the elbows or knees. These lesions come out in crops and tend spontaneously to slow involution. On account of their color and consistency they are occasionally called "fleshy" papules. On the palms and soles, however, they are shotty and persist longer than elsewhere, leaving hyperpigmented spots. Frequently the papular lesions are pronounced about the nose and mouth. In the angle between the nose and the cheek they are often hypertrophic and at the corners of the mouth they are split, forming the lesions known as the split papules. Such lesions as are lichenoid are flat-topped, dark-red papules surmounted by a few fine scales, have bases which are angular; and they are likely to be arranged in annular patterns.

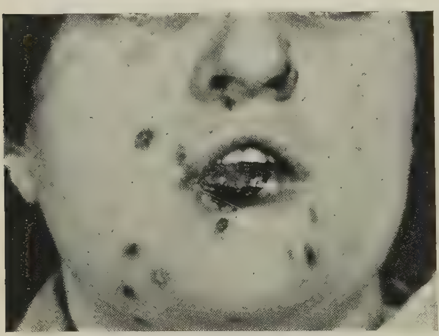

Fig. 555.—Chancre of lower lip, with secondary lesions present on the face and body. (Courtesy of Dr. Mihran B. Parounagian.)

A follicular variety of early syphilide, which causes acneiform papules at the pilosebaceous orifices, is rare. The individual lesions are pointed, reddish-brown papules capped by a small scale and varying from the size of a pinhead to that of a split pea, often being grouped. They are distinguished from acne vulgaris by the absence of comedones and by their sudden appearance and widespread distribution.

The small papular syphilide must be differentiated from lichen planus, psoriasis, eczema, and keratosis pilaris. In the small papular syphilide the lesions are acuminate, dark red or brownish papules, and have a tendency to grouping, but do not fuse. There is the history of the presence of other syphilitic manifestations. In lichen planus the involvement is chiefly of the wrists and forearms, inner thighs, and legs, and the papules are flat and shiny, with irregularly angular bases, and a tendency toward umbilication. In eczema the papules are bright red and pruritic and tend to form patches. There are usually vesicles and vesicopapules mixed with the papules. Psoriasis of the guttate type has a predilection for the extensor surfaces of the elbows and knees, and there is, as a rule, a history of preceding psoriatic lesions on these areas or on the scalp. The scales are micaceous and when they are removed leave bleeding points. There are no pustules in psoriasis, whereas they may be scattered among the papules in the small papular syphilide. In keratosis pilaris and pityriasis rubra pilaris there is a long duration and the papules are follicular with central horny spines so that when they form patches the surface feels like a nutmeg grater. Keratosis pilaris usually affects the outer surface of the arms and thighs, whereas in pityriasis rubra pilaris there is a predilection for the scalp and trunk, and the dorsal aspects of the proximal phalanges of the fingers. In the latter disease the papules fuse to form widespread erythematous scaling patches, but the isolated individual papules look like small black points.

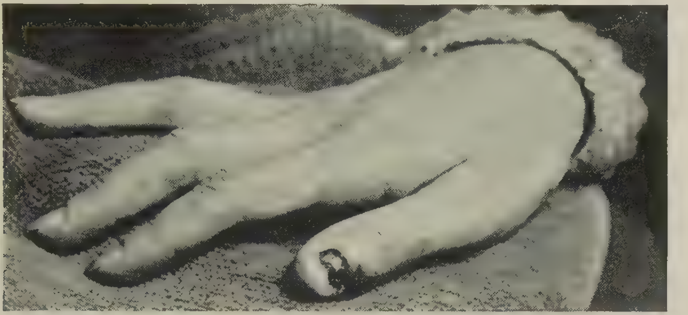

Fig. 556.—Chancre of thumb. (Courtesy of Doctors J. B. and Bedford Shelmire.)

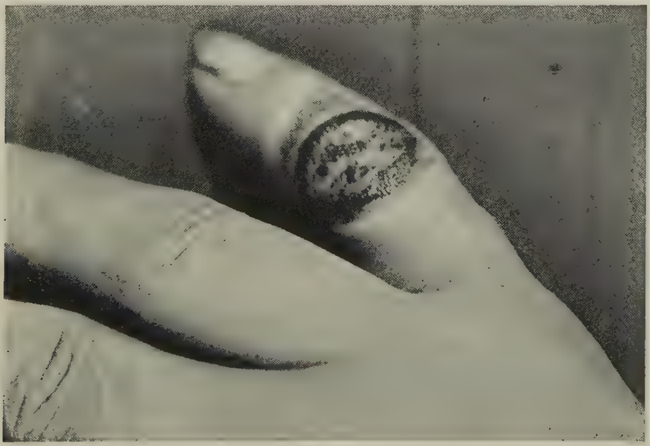

Fig. 557.—Chancre of index finger. (Courtesy of Dr. Mihran B. Parounagian.)

The large papular syphilide is usually so characteristic that the diagnosis is easily made. The papulosquamous syphilide may be confused with psoriasis, but has the tendency to scale less and to be of a coppery color and more infiltrated. In addition, the papulosquamous syphilide is located upon the flexor surfaces at least as profusely as upon the extensor aspects. These features, together with the presence of mucous patches, condylomata, split papules, adenopathy, and other signs of secondary syphilis, assist in the diagnosis.

Intermediary or Late Secondary Manifestations.—*Arrangement.*—Like the other syphilides, papular eruptions tend to be disseminated in the early course of the disease and later become more or less localized, configurate, hypertrophic or confluent. Grouping is then a characteristic, its recognition being a diagnostic aid of great value. The same form of lesions is encountered as in the earlier outbreaks. The arrangement may be corymbose or in patches, rings, or serpentine patterns. A follicular tendency is noted at times, and when the eruption is a pure follicular syphiloderm it is reputed to be associated with cerebrospinal involvement. The corymbiform type of eruption is a rare variety of follicular involvement characterized by a cluster of small lesions about a larger central papule. The annular syphilide may consist of incomplete rings or concentric figures in the form of rosettes. The annular lesions are most common in those who have dark skins, especially on the face. Serpiginous lesions in the majority of instances arise late in the secondary period and during the tertiary period from a single papule by peripheral spreading and central involution.

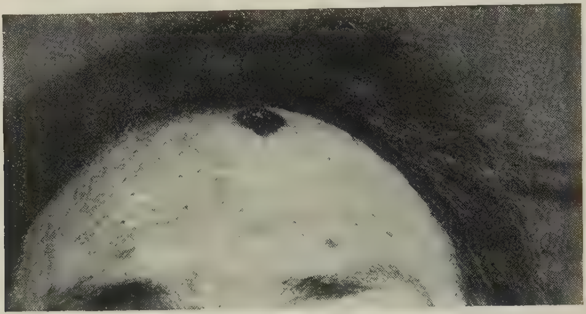

Fig. 558.—Chancre of forehead. (Courtesy of Dr. Mihran B. Parounagian.)

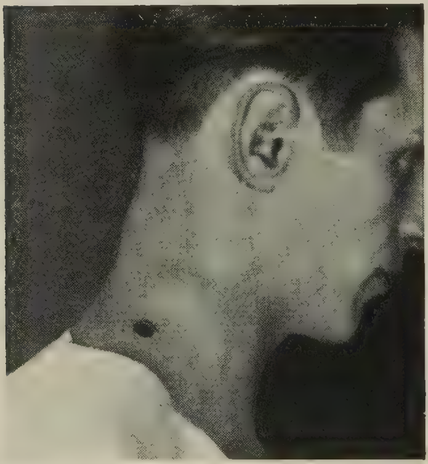

Fig. 559.—Chancre of neck. Note cervical adenopathy. (Courtesy of Dr. Mihran B. Parounagian.)

Condylomata.—Whenever papular lesions are located on moist or apposing surfaces, they may become hypertrophic and are known as condylomata, having a macerated whitish surface covered by serous exudate. These lesions are highly infectious and indolent, and give rise to no discomfort. The condyloma of syphilis is generally a flat, slightly elevated, spongy, grayish lesion, which must be distinguished from the pointed condyloma—condyloma acuminatum—which accompanies gonorrhea and other chronic purulent genito-urinary infections. Both types sometimes resemble the ordinary wart—verruca vulgaris. Syphilitic condylomata occur about the anus and genitalia, in the groins, armpits, and about the mouth, nose, and eyelids. They are most frequent about the female genitals due to moisture and coaptation of the folds of the skin.

Other Signs.—Intermediary secondary eruptions are accompanied by mucous patches on the tonsils or labia, in addition to the condylomata. These manifestations are not present, however, in the early syphilides.

In association with these cutaneous manifestations there may be falling of the hair—the eyebrows and beard, as well as of the scalp. The alopecia is irregularly distributed in patches, so that the scalp has a moth-eaten appearance. The falling of the hair may be due to syphilitic infiltration of the hair follicles or to involvement of the cervical sympathetic nerves. The nails likewise may be involved, either from local inflammation due to the treponema, from suppuration, or from the constitutional derangement.

Leukoderma Colli.—In brunettes and especially in women, coincident with the appearance of the macular eruption or within several months following it, a pigmented mottling may be manifest on the sides and back of the neck and, more rarely, on other parts. It may be composed simply of brown stains at the sites of the papules, in which case the pigmentation disappears slowly of its own accord and is not influenced by treatment. On the other hand, there may be a diffuse tanning which is interspersed with many spots of depigmentation. Most often there are variously sized small round or oval, ill-defined, depigmented spots (leukoderma colli), surrounded by hyperpigmented areolae, so that a dappled appearance results. Although of syphilitic causation, the leukoderma is usually not responsive to antisyphilitic remedies and persists indefinitely.

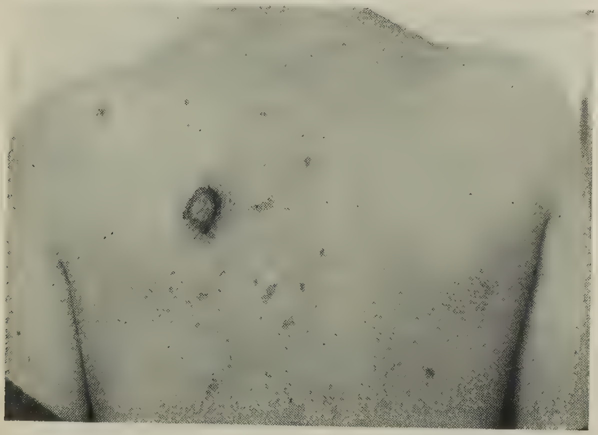

Fig. 560.—Chancre of back. Secondary lesions are also present. (Courtesy of Dr. Joseph V. Klauder.)

Pustular Syphilide.—If the disease is virulent or the resistance of the individual is low, pustular or rupial lesions may develop. The two types are infrequently observed and indicate a malignant course of the disease. The pustular lesions may be primary or may form from previously existing papules. The small pustular syphilide consists of discrete, flat, more or less grouped, pea-sized lesions. The eruption is usually profuse, with a centripetal tendency, *i. e.*, the majority of lesions are upon the median parts of the trunk. Some lesions may be crusted or ulcerated.

The large pustular syphilide may be superficial or deep. Both of these varieties are also widely distributed and characterized by pustules and by crusted ulcerations. Rupial lesions are caused by the accumulation of lamellae of crusts on the surface of large pustules, the appearance suggesting

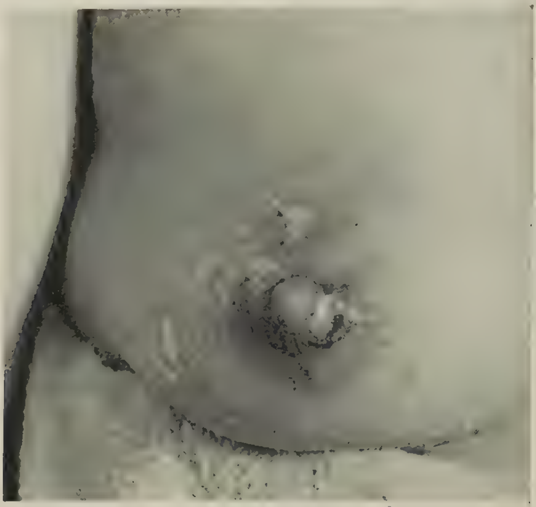

Fig. 561.—Chancre of breast

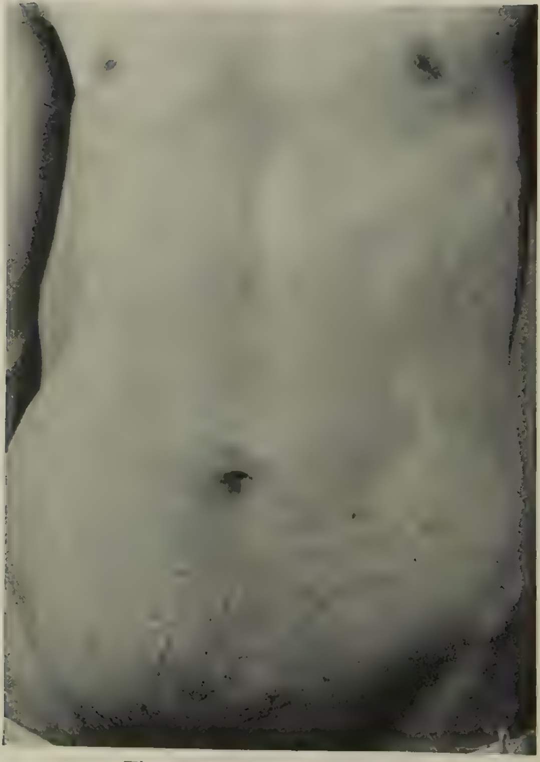

Fig. 562.—Macular syphilide.

small oyster shells. Such lesions are rare and occur in debilitated patients, usually late in the secondary period about a year after the chancre.

Squamous Syphilide.—Another intermediary or late eruption is the squamous syphilide, which consists of smooth or scaly, thickened patches, with elevated and irregularly scalloped borders. Either one palm or one sole is usually affected, but sometimes these squamous lesions are generalized. The scaling may be branny or coarse. On the soles, similar lesions to those found on the hands may develop and lead to unilateral hyperkeratoses, which are often associated with painful fissures. The appearance frequently suggests psoriasis, from which disease the squamous syphilide is distinguished

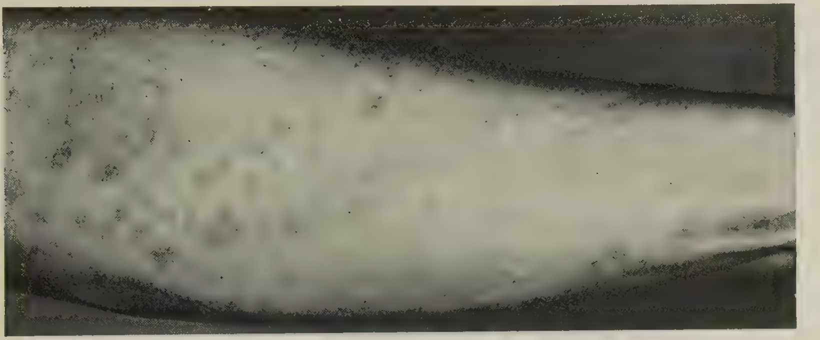

Fig. 563.—Relapsing macular syphilide of the arm.

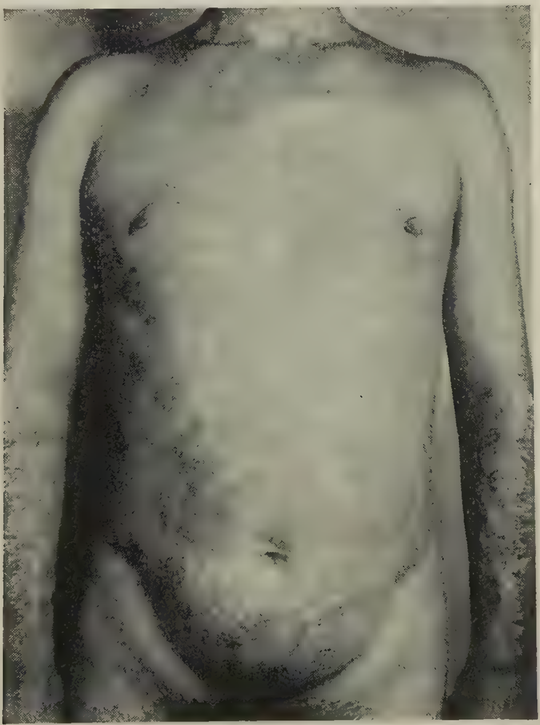

Fig. 564.—Relapsing macular syphilide.

by infiltration, configuration, unilateral involvement, predilection for the flexor surfaces and often by the character of the scales. The syphilitic lesions are differentiated from palmar eczema by their tendency to be limited to one palm, and to involve only a part of it, whereas eczema usually affects the entire surface of both palms more or less extensively; by the well-defined, elevated, and indurated borders, and by the infiltration beneath the lesion, all of which are absent in eczema. The latter is associated with intense itching, which is lacking in syphilitic eruptions.

Differential Diagnosis.—The small pustular syphilide may be mistaken for impetigo contagiosa or pustular eczema. This type of syphilide is a more generalized eruption which occurs between the ages of twenty and forty-five. The lesions have a tendency to be grouped and to form adherent, dirty crusts. In impetigo the early lesions are seropurulent vesicles or bullae which rupture spontaneously and form light crusts which are easily removed, and the involvement is principally in one or two regions. Impetigo and pustular eczema are most common in children, although they may occur at any age. In pustular eczema vesicles are frequently encountered and the patches are surrounded by considerable erythema and swelling, and are pruritic.

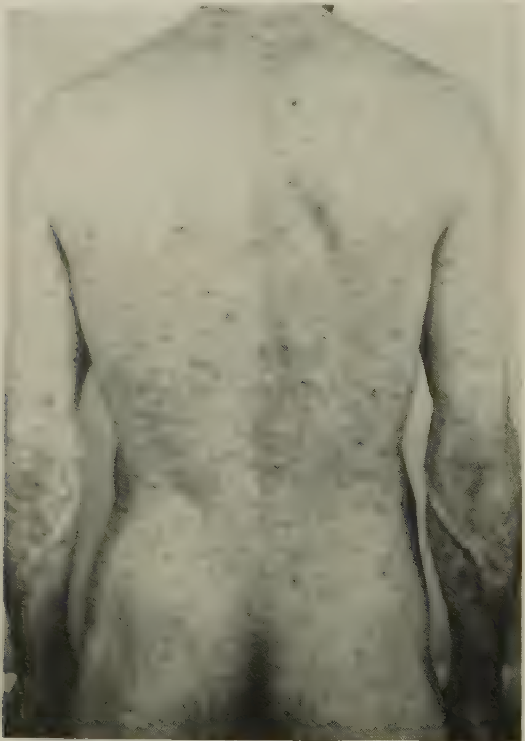

Fig. 565.—Maculopapular syphilide.

The large pustular syphilide may be confused with variola, drug eruptions or acne vulgaris. In variola there are severe constitutional symptoms and a tendency for the eruption to be centrifugal, *i. e.*, distributed principally upon the terminal parts of the extremities (hands, wrists, feet) and on the face, particularly the nose, chin, and forehead. The syphilitic eruption is polymorphous and generalized, with a tendency to be chiefly upon the trunk (centripetal). Other evidences of syphilis are often present. The lesions of variola feel distinctly shotty, being hard and deep. Drug eruptions are usually milder than either of these diseases and are often associated with bullae or are of atypical distribution, and there is the history of the ingestion of drugs. In acne vulgaris the disease is limited to the face, back, and chest, where there are numerous comedones and scars in association with the other lesions.

Mucous Membrane Lesions.—These frequently accompany the cutaneous manifestations. The most common in the early phase is a diffuse pharyngitis, which may be associated with tonsillitis or laryngitis. After the earliest generalized eruptions there may appear desquamating patches on the tongue analogous to the papular eruption on the skin. Such patches are usually on the dorsum near the median raphe and consist of one or several small or large, smooth, well-defined areas devoid of papillae. The best known and most characteristic mucous membrane lesion is the mucous patch, which may accompany the eruptions of the intermediary period, but is not observed in the early stages. Mucous patches, which are macerated papules, appear as flat, grayish, rounded erosions covered by a delicate soggy membrane. These lesions are about 5 mm. in diameter and teem with treponemata, so that they are very infectious. They occur on the tonsils, tongue, and

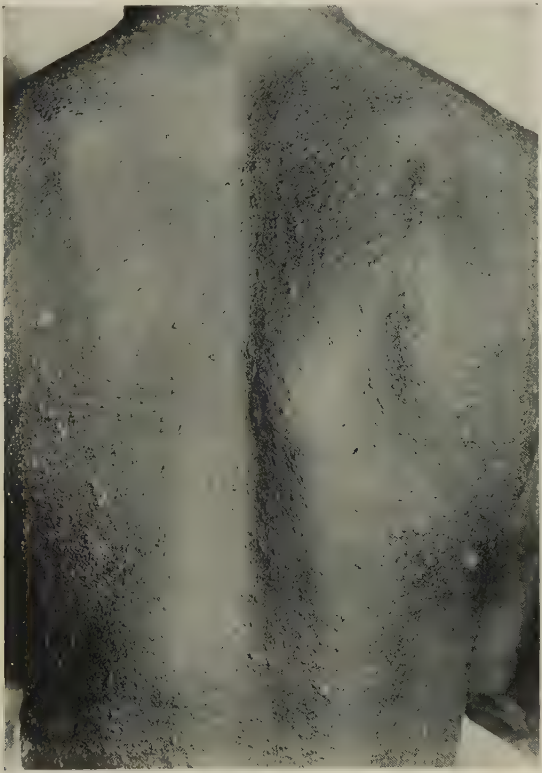

Fig. 566.—Follicular syphilide.

pharynx and also on the gums, lips, and buccal areas, or about the genitalia, especially in women. In the latter location they are most common on the labia minora, the vaginal mucosa, and the cervix. Such mucous erosions are transitory and change from week to week, or even from day to day. Ulcerations often occur on the tongue and lips during the late secondary period, usually at the point of irritation from dirty or jagged teeth.

The differentiation of mucous membrane lesions of the secondary period from other affections is of great diagnostic importance. Geographical tongue may be confused with the desquamative patches of syphilis or with mucous patches by the inexperienced. Lingua geographica occurs principally near the edges of the tongue in relatively large areas, which are often fused and have lobulated contours, and upon questioning one finds that the condition has been present for several months or years and changes in extent and degree of involvement from day to day, in conformance with its other name—wandering rash of the tongue. Aphthous stomatitis produces one or several painful ulcers, 1 to 3 mm. in diameter, surrounded with hyperemic edges, which features are distinctive.

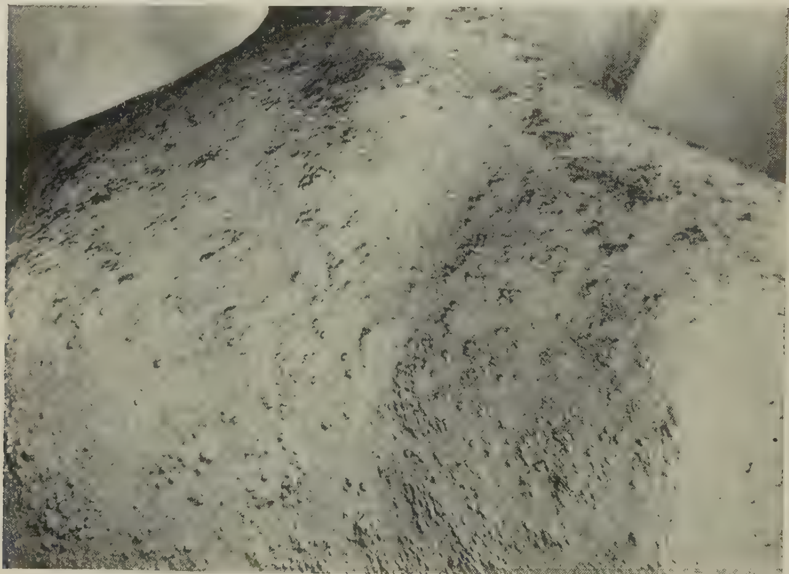

Fig. 567.—Follicular miliary papular syphilide.

The *differential diagnosis of syphilis of the mucous membranes* presents greater difficulties than that of the skin because of the modifications in the elementary lesions due to moisture and other factors. In suspected cases it is important that the entire integument should be examined and a Wassermann test should be done. The most common cause of clinical errors in judgment is due to failure of the physician to keep in mind the prevalence of syphilis. Syphilitic sore throat is frequently at first regarded as Vincent's angina, streptococcus sore throat, or diphtheria. Carcinoma of the tonsil, tongue, or lip is often confused with early syphilitic lesions.

Recurrent Eruptions.—The early lesions of syphilis involute either spontaneously or under treatment, but relapses may occur when the defense reaction of the body has dwindled and become insufficient for protection. Such relapses may take place at the site of previous lesions, on the skin or in the viscera. The cutaneous recurrences may be generalized eruptions in the form of large sparse, lichenoid, annular, scaly, psoriasiform, or nodular lesions. In recurrent eruptions there is a distinct tendency toward increased configuration and infiltration, and the lesions are larger and separated by wider areas of healthy skin. For several years after the onset of the disease, recurrent lesions are dangerously infectious. Stokes suggests that the physician dealing with early syphilis should be on the lookout for any one or several of the following forms of cutaneous relapses in any given case: (1) Reappearance of the chancre; (2) delayed secondaries which may appear several years after insufficient treatment during the primary stage; (3) complete recurrence of a secondary eruption, and even of a primary lesion in combination with secondaries following inadequate treatment; (4) appearance of isolated recurrences, especially of the buccal and anogenital lesions, with the patient apparently in good health and even with a negative blood Wassermann reaction as late as several years after the onset of the disease.

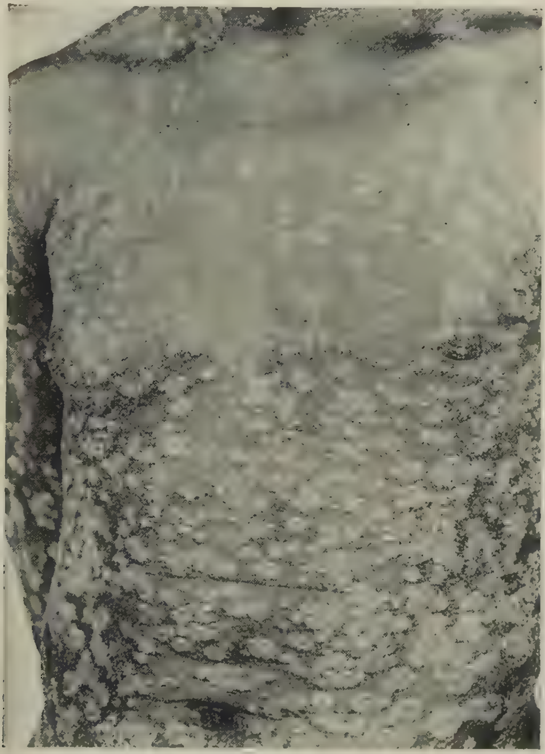

Fig. 568.—Follicular syphilide, with scaling.

Serological Relapses.—Serological relapses in early syphilis or the persistence of doubtful, weakly or strongly positive Wassermann tests is at times inexplicable, but, as a rule, should be considered evidences of activity of the disease although the focus may remain unidentified. These serological symptoms usually demand persistent treatment by salvarsan or other rem-

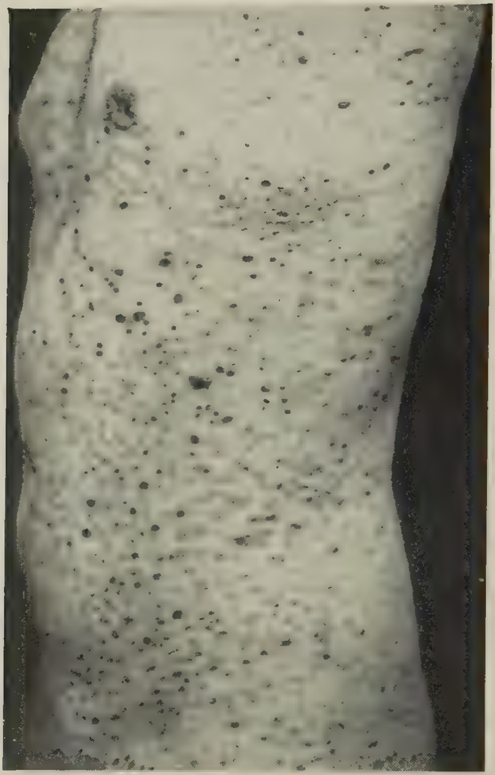

Fig. 569.—Large papular syphilide. (Courtesy of Dr. A. Benson Cannon.)

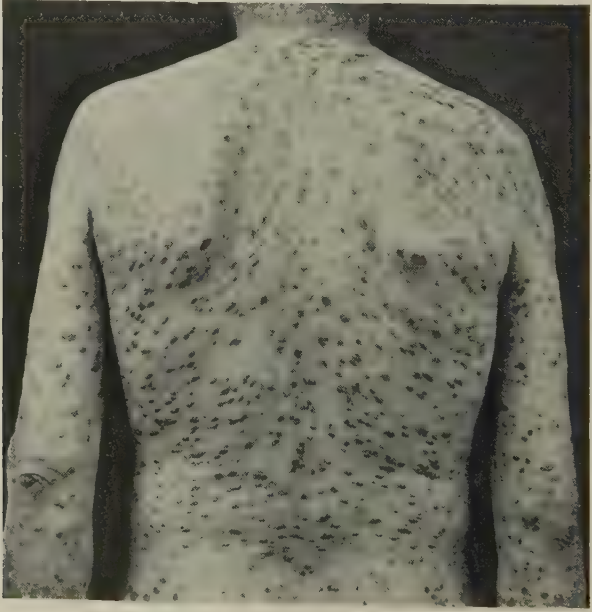

Fig. 570.—Lenticular syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

edies. In recalcitrant cases it is advisable to change from one remedy to another when the ineffectiveness of one has been demonstrated. Wassermann reactions which persist positive in spite of thorough treatment with neosalvarsan or old salvarsan at times yield to silver salvarsan or sulpharsphenamine. One should make use of the variety of drugs at command for treatment in all relapsing or recalcitrant cases.

Tertiary Syphilis.—After the defense mechanisms of the body have somewhat overcome the spirochetal invasion, the parasites become more or less eradicated from the blood stream and general tissues and are localized in a few foci. Such residual organisms may be held in restraint by the individual's defense reaction or by treatment for an indefinite period, but from time to time tend to display periods of activity, so that during its late stages the disease is localized and its course is cyclic. This late and localized stage of syphilis has long been designated the tertiary period. This term is being largely replaced by that of late syphilis, because it is misleading to think of the disease as divided into definite periods, as before stated.

The cutaneous lesions of late syphilis are not only localized but are likely to lack the symmetry which is characteristic of the earlier eruptions. The lesions may be single or multiple, superficial or deep nodules, or tumors characterized by indolence, painlessness, a tendency to ulceration in one part simultaneous with healing in another, distinctive scar formation, and, last but not least, by grouped and configurate arrangement. The late cutaneous manifestations are the nodular or tubercular syphiloderm and the gumma.

Nodular or Tubercular Syphilide.—The nodular or tubercular type consists of reddish-brown or copper-colored firm lesions, split-pea sized or larger, which have a tendency to form in groups and in circinate or serpiginous patterns. Such patches are composed of several nodules which are in different stages of development and resolution, so that it is common to find scars and pigmentations together with ulcerations and evoluting fresh lesions. The ulcerations are deep, with sharply cut edges, which give them a punched-out appearance; the floor is covered with crusts and a gummy exudate. Crescentic or serpiginous ulcerations are not uncommon. The nodular syphilide is generally of from three to six months' duration, although occasionally one encounters lesions which have been present for many years. It must be differentiated from several diseases. In lupus vulgaris the beginning is usually during childhood with a persistence of the lesions throughout adult life. The patches are composed of soft nodules, the color of apple jelly, and these have a tendency to ulcerate, leaving undermined and irregular edges, thin crusts or pliable white scars, about which there is often hyperpigmentation. Active nodules appear within the scar tissue, a thing generally not seen in syphilis. Epithelioma occurs most frequently in those of middle age and is a slow process, leading to ulceration. The most common locations are on the face and hands, while the nodular syphiloderm has a predilection for the nose, forehead, and back, but the lesions may develop anywhere.

Gumma.—This is usually a single isolated tumor which forms fairly rapidly, often after a local injury, and runs an indolent course. At the beginning it is a small nodule covered by a normal epidermis, but within a few weeks it commonly attains a diameter of one or more centimeters and the overlying skin becomes erythematous. The gumma is of the nature of a cold abscess and is distinctive because of its painlessness, and the absence of surrounding hyperemia. In its early stages palpation reveals a somewhat elastic consistency, but a little later there is fluctuation and the mass ultimately breaks through the skin, so that an excavation is formed with steep sides, irregular borders, and a base which is covered by a gummy exudate. The destruction usually involves the subcutaneous tissue and corium and may extend deeper. Not infrequently the lesions originate in periosteum or bone, and a common location is at the sternoclavicular junction, although they may arise in any part of the body. Occasionally a gumma undergoes a fibroid transformation instead of breaking down. Such fibroid gummata usually arise in subcutaneous tissue and are covered by normal skin. A special and rare variety occurs in a symmetrical manner over the extensor surfaces of articulations, usually on the elbows. These lesions are adherent to the capsule of the joint and are called juxta-articular nodules. Their composition is so firm that when palpated they suggest an osteoma or an encapsulated new growth.

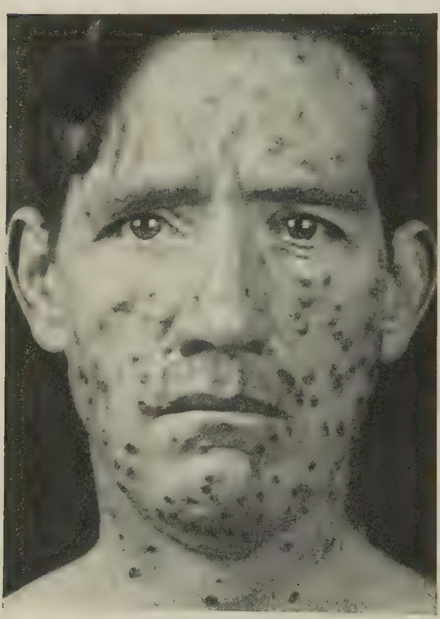

Fig. 571.—Large papular syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

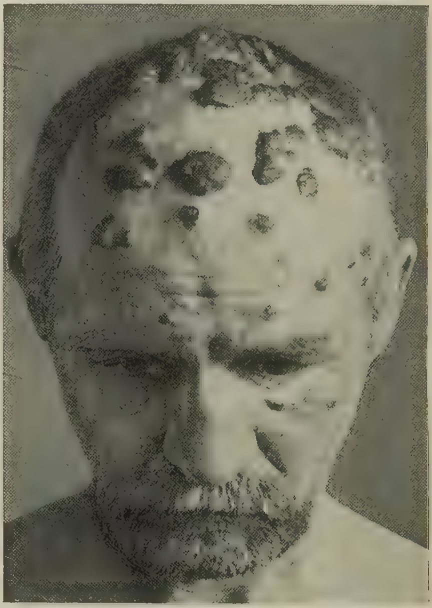

Fig. 572.—Pustular syphilide of the rupial type. (Stelwagon.)

The gumma must be differentiated from epithelioma, varicose ulcer, and tuberculous ulcerations. Epithelioma, particularly the rodent ulcer type, may lead to confusion. In rodent ulcer the pearly, hard, rolled border is almost always recognizable in some part of the lesion and the duration is likely to be longer than that of tertiary syphilis, in the former being two to ten years, whereas in the latter it is a matter of months. The lesions in varicose ulcer are irregularly shaped, with cordlike or undermined borders, while gummatous ulcerations are generally circular with steep sides so that there is a punched-out appearance. Varicose ulcer occurs most often on the lower part of the leg or ankle and is associated with varicose veins;

syphilitic ulcers are more common below the knee, where they are often multiple and arranged in a configurate pattern. In tuberculous ulcerations the onset is generally in childhood or adolescence and the lesion is slowly progressive with the formation of a ragged, undermined border and an irregular white scar. The floor of the tuberculous ulcer is dirty and covered with a foul exudate. The ulcerations of erythema induratum have a predilection for the backs of the legs, where there are multiple indolent nodules which undergo a central necrosis and tend to form depressed scars without at any time producing the gummy exudate characteristic of the syphilitic lesion. Erythema induratum occurs principally in women between the ages of twenty and thirty, at which time tertiary syphilitic lesions are very unusual. Ulcerations in leprosy may simulate syphilitic gummata, but are likely to be surrounded by a zone of anesthesia and to be associated with other manifestations of the disease.

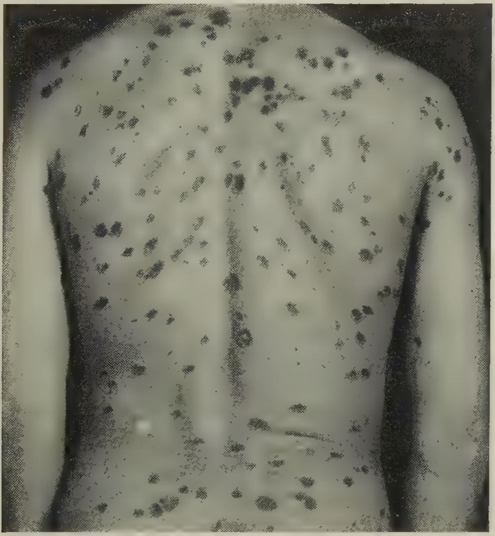

Fig. 573.—Papulosquamous syphilide of trunk and legs. (Courtesy of Dr. Mihran B. Parounagian.)

Late Mucous Membrane Lesions.—In late syphilis the mucous membranes are attacked, the tongue being a favorite site. Gumma of the tongue usually affects the central portion and rapidly breaks down to form the typical punched-out ulcer with irregular soft edges. Gumma may be differentiated from carcinoma by the fact that the latter is invariably hard and generally attacks the edge of the tongue or occurs on the floor of the mouth or on the buccal mucosa. Other distinguishing features are the absence of pain and adenopathy in gumma, and their presence in cancer. In case of doubt a tissue examination should be made, for many patients with carcinoma of the tongue also have syphilis, which latter, however, is relatively unimportant in the presence of malignant neoplastic disease.

A superficial glossitis may cause irregular ulcers, atrophy of the papillae, and smooth shiny scarring, which condition is known as *smooth atrophy.* In interstitial glossitis there is an underlying induration due to sclerosis. In the advanced stages tertiary syphilis of the tongue may lead to a diffuse enlargement (macroglossia).

Leukoplakia (see page 990) is present in many cases of syphilis. While it is not *per se* a syphilitic process, syphilis combined with chronic irritation from smoking and chewing tobacco is the usual cause. Leukoplakia is divided into the quiescent and active types, although these are more correctly

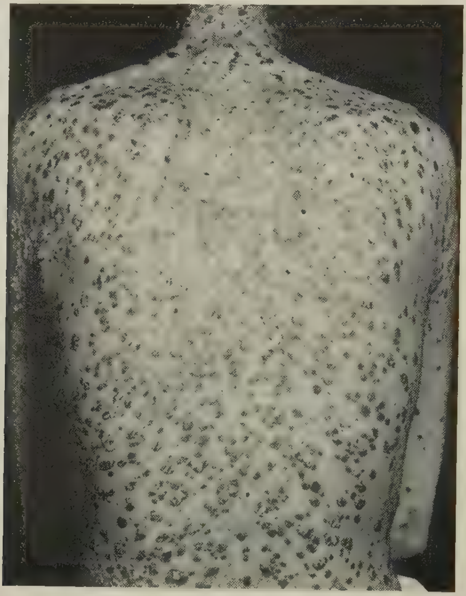

Fig. 574.—Psoriasiform secondary syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

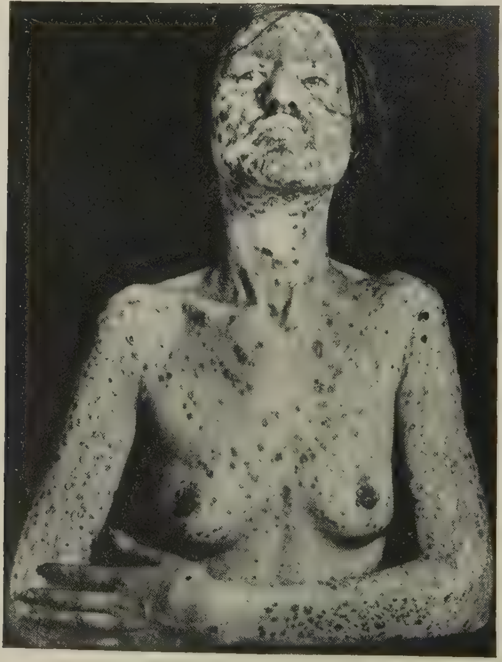

Fig. 575.—Extensive psoriasiform syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

but phases in the process of the disease. The lesions of the quiescent type do not increase in size during prolonged observation and produce no symptoms. Those of the active type are surrounded by an erythematous zone or are scaly, split, tender, or superficially ulcerated. The lesions are sensitive to heat, spices, acids, or coarse foods, and tend to increase gradually in dimensions. A severe variety of leukoplakia associated with interstitial glossitis causes a firm thickening of the tongue, with hypertrophied papillae, on which there is a verrucous white covering, producing what is called "cobblestone-tongue." It is important to bear in mind that leukoplakia,

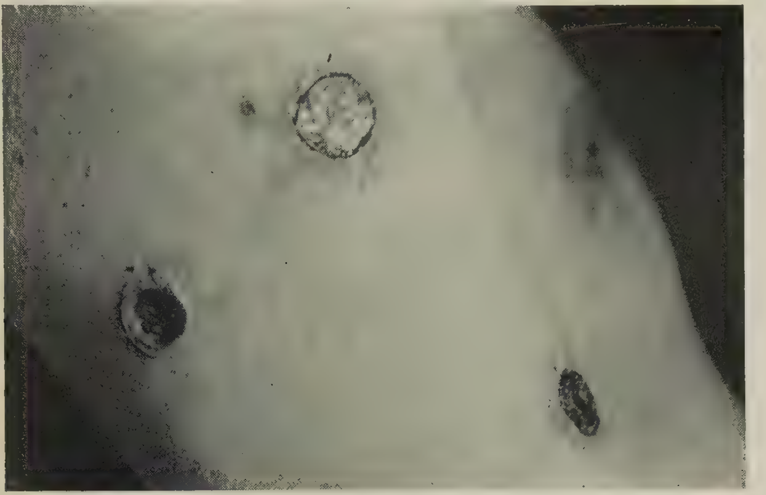

Fig. 576.—Ecthymatous syphilide. (Courtesy of Dr. A. M. Davidson, Winnipeg, Canada.)

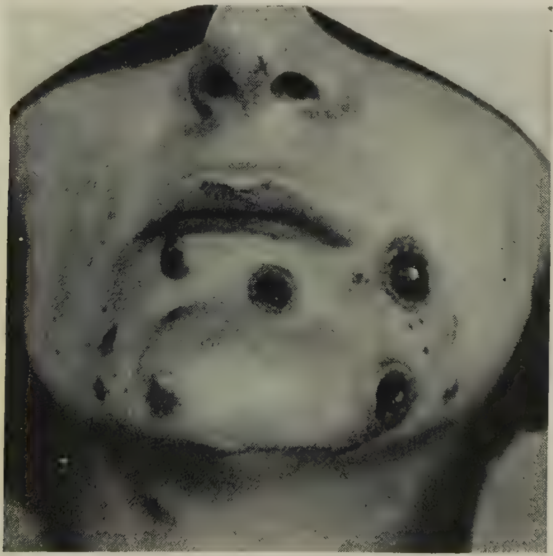

Fig. 577.—Ecthymatous secondary syphilide.

especially the active varieties, is a lesion upon which carcinoma tends to develop.

Perforation of the hard palate from gummatous involvement is a characteristic tertiary manifestation. It generally occurs near the center of the hard palate, but it may attack the soft palate, destroy the uvula or cause necrosis of the nasal bones.

Late syphilitic disease of the tongue must be differentiated from several other affections to which it has a close resemblance. The chief features which distinguish gumma from carcinoma have already been given. Leukoplakia must be differentiated from lichen planus, which is not easy unless the typical papules, reticulation or configuration of the latter disease are present. Scrotal tongue is a congenital anomaly in which uniformly arranged fissures radiate feather-like forward and outward from the median raphé without evidence of inflammation. In another anomaly, which is less conspicuous, the edges of the tongue apposed to the teeth have a markedly serrated contour. The atrophic glossitis associated with chronic gastrointestinal disease or with anemia, and the infiltrations of the tongue which are observed in leukemia, Hodgkin's disease, mycosis fungoides, and leprosy should not lead to any difficulties in diagnosis. Leukoplakia does not occur in infants, and thrush of the mouth is not found in adults except rarely, when

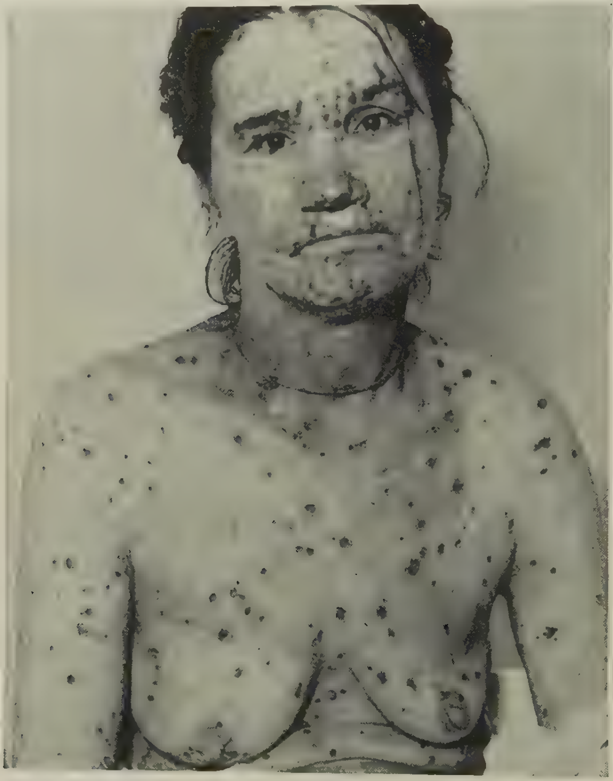

Fig. 578.—Secondary syphilis, with pustular ulcerated lesions. (Courtesy of Dr. Edward A. Oliver.)

its recognition is easy on account of its peculiar mosaic-like appearance and the demonstration of the fungus microscopically.

Fig. 579.—Corymbiform secondary cutaneous lesions. Note the central larger papule with grouped small papules in a surrounding cluster. (Courtesy of Dr. Adolph Rostenberg.)

DIAGNOSIS OF SYPHILIS

The detection of the signs of visceral syphilis or syphilis of the central nervous system may assist in the diagnosis of cutaneous lesions. During the tertiary period of the disease there is a tendency to localization, especially in the nervous and cardiovascular systems. Syphilis is the most frequent cause of aortitis, aortic insufficiency, and aneurysm of the aorta and a frequent cause of myocarditis. Periostitis may occur, particularly on

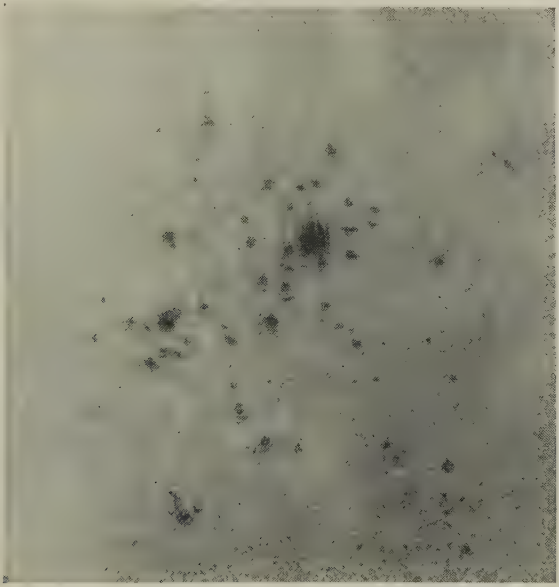

Fig. 580.—Corymbiform syphilide. Lesions are life size, occurring on the back.

the tibia or skull. Gummata may be present in any place, but are most commonly found at the sternoclavicular articulation, in the nasopharynx, in the testicles, or in the liver. The vision may be affected by optic atrophy, iritis or retinitis.

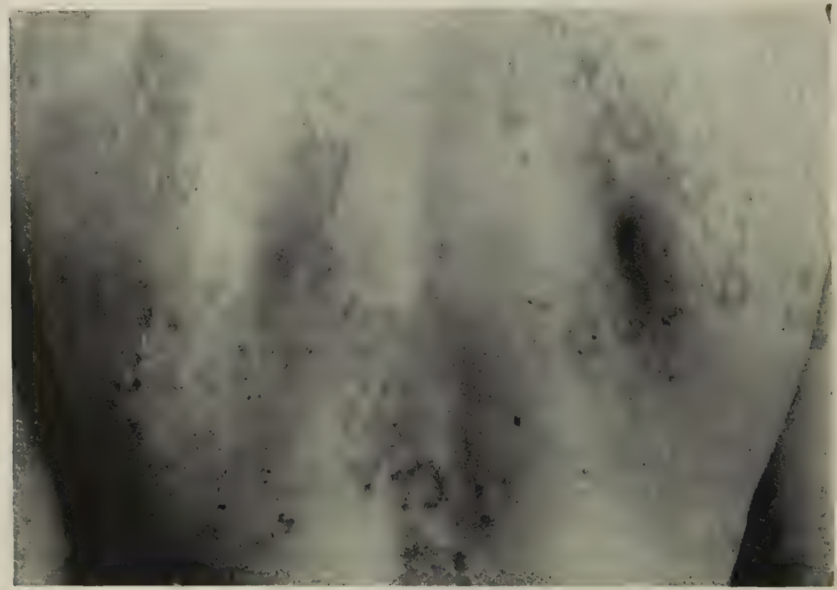

Fig. 581.—Grouped secondary syphilide of the back.

Cerebrospinal involvement is present in about 10 per cent of syphilitics. The symptoms and signs of tabes and paresis, and the clinical features and unfortunate accidents of the vascular type of cerebrospinal syphilis are beyond the scope of this work, but are an intrinsic part of syphilology. Syphilitic meningitis, gumma of the brain, and other uncommon manifestations of cerebrospinal syphilis are sometimes encountered.

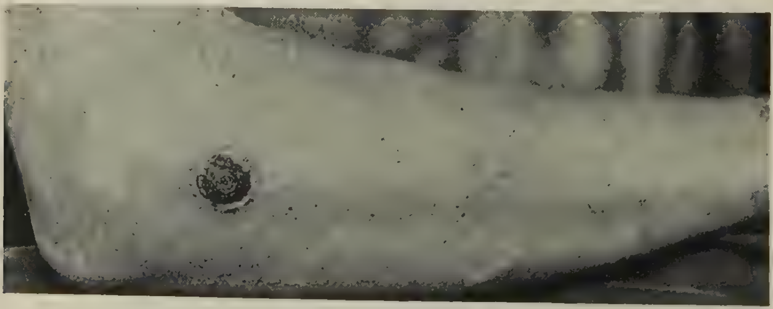

Fig. 582.—Rupial syphilide. (Courtesy of Dr. A. Benson Cannon.)

A history of conception terminating in either abortion or miscarriage is another important indication of syphilis. Many syphilitic women have suffered from both gonorrhea and syphilis and are, therefore, sterile on account of the changes produced by the gonorrhea. This fortunate outcome does not always supervene. Pregnancy may take place and the result depends somewhat upon the stage of the disease at the time of impregnation. If the infection occurs during the early part of pregnancy, the fetus is usually aborted, and if the infection occurs in the later months, the child may go to term and may be born apparently healthy, although generally with a positive Wassermann test and the likelihood of developing lesions of syphilis during the first year, especially during the first three months. The most common effect of syphilis in either parent is a stillbirth. Spontaneous miscarriages, particularly repeated ones after the early months of pregnancy, are of diagnostic assistance. Usually in syphilitics each subsequent pregnancy is likely to be of longer duration than the preceding, so that of five pregnancies a typical history would be that the first miscarried at three months, the second miscarried at five months, the third was a stillbirth at seven months, and the fourth was a child born prematurely at eight months, which died of marasmus when a month old, and the fifth was a full-term child and is living and apparently well.

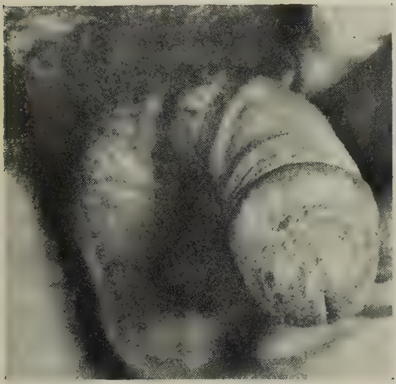

Fig. 583.—Scaling syphilide of glans penis.

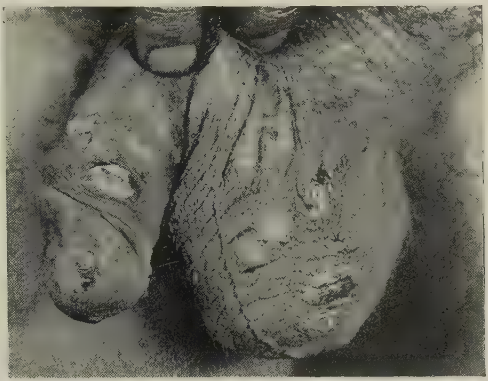

Fig. 584.—Involuting chancre just above the coronary sulcus, with secondary papular lesions on glans, shaft, and scrotum.

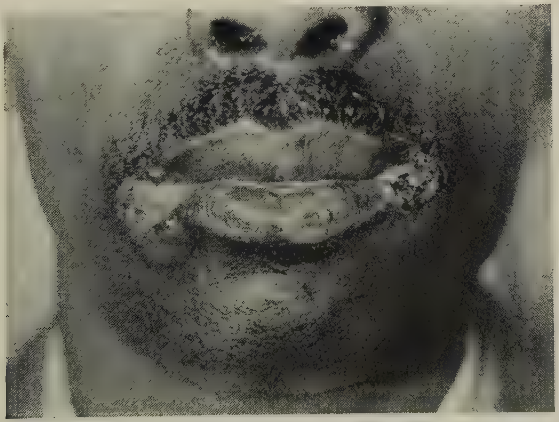

Fig. 585.—Hypertrophic split papules at oral commissures in secondary syphilis.

The clinical manifestations of syphilis are often sufficient to establish the diagnosis in the mind of the physician, but the existence of the disease has such a weighty effect upon the patient's horizon that the clinical impressions should properly be confirmed by laboratory examination. The final diagnosis rests upon an estimation of the clinical and laboratory findings. Diagnostic laboratory procedures have attained a refinement which assures greater accuracy than is possible in clinical methods. In the chancre period the dark-field examination has an importance so great that it should be more generally employed. It makes possible the early diagnosis and institution of treatment, which with modern methods practically assure a favorable prognosis.

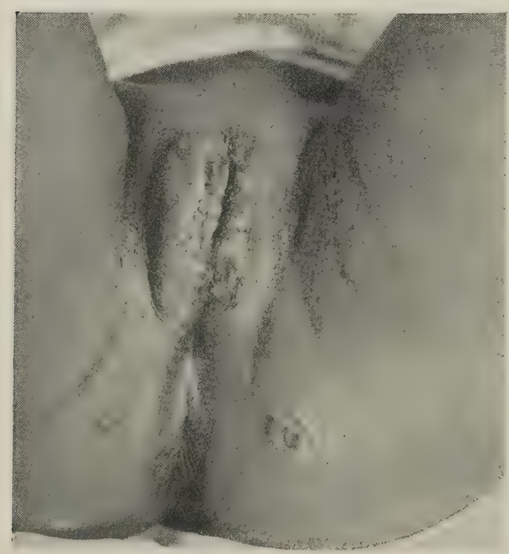

Fig. 586.—Chancre of the vulva and secondary lesions on vulva and buttocks in six-year-old child.

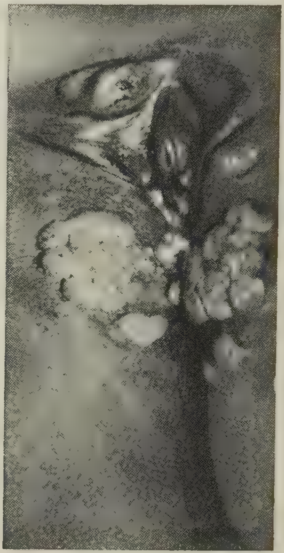

Fig. 587.—Double chancre of vulva and perineal condylomata lata in colored child of six years. Gonorrheal infection also present. (Courtesy of Dr. Mihran B. Parounagian.)

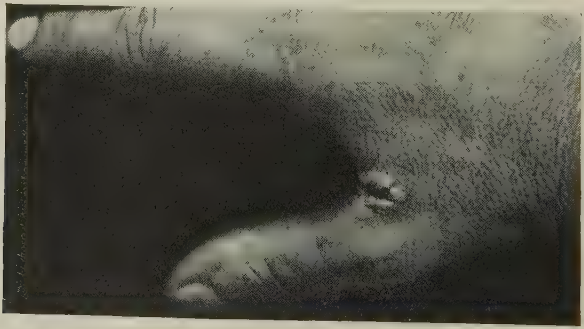

Fig. 588.—Condyloma of web of thumb. (Courtesy of Dr. Mihran B. Parounagian.)

The Wassermann test has assumed an importance beyond description and is constantly relied upon for the final diagnosis of syphilis, and as a guide to the improvement attained by treatment. Of course the ground covered by this one test is so extensive that its uses are subject to modifications under particular circumstances. The later tests comprising the precipitation reactions of Kahn, Vernes, and Sachs-Georgi, especially the one of Kahn, are receiving increasing recognition for reliability. The laboratory examination of the spinal fluid by cell count, globulin test, and colloidal gold reaction, in addition to the Wassermann test, has such definite diagnostic value that it is used as a matter of routine.

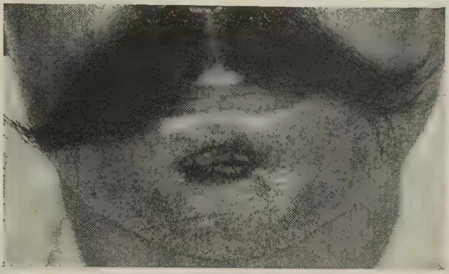

Fig. 589.—Condylomata lata on chin. Secondary syphilis. (Courtesy of Dr. Mihran B. Parounagian.)

Dark-field Examination. –*Apparatus.*—The original apparatus for the examination of so-called "ultramicroscopical particles" was devised by Siedentopf and Zigismonde and this was later simplified by Reichert. The instrument is used for the demonstration of the Treponema pallidum. With this apparatus very minute particles and living organisms which can scarcely be identified by ordinary microscopes can be clearly distinguished. The principle of dark-field illumination is explained by the particle of dust which is visible in a sunbeam entering a dark room. The light which illuminates the object has a greater refraction than the cone of light which enters the objective and produces the image. The illuminated objects are clearly defined against the dark background.

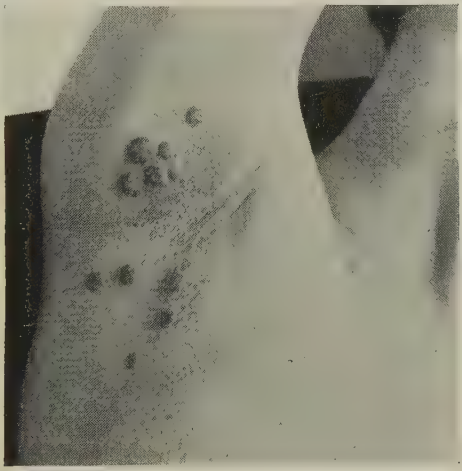

Fig. 590.—Condylomata lata in axilla. (Courtesy of Dr. Binford Throne.)

Directions for Use.—The Abbé condenser is removed and the dark-field paraboloid condenser is substituted for it. With the low power objective the dark-field condenser is centered. A circle is observed against the black background and the position of this circle is adjusted by manipulation of set-screws so that the circle is at the center of the microscopical field. The adjustment is made by studying the position of the circle through the low power eye-piece and objective. The illumination is derived from a special electric substage bulb, from a Welsbach mantle, a carbon arc or a 100-watt nitrogen tungsten lamp. The source of illumination should be adjusted so that the bright circle is centered with the field and is equally bright in all parts of it. Examinations are usually made with the 1/12 oil immersion objective in which it is necessary to insert a funnel-shaped reducer to cut down the aperture. The most important parts of the arrangement are the centering of the circle of the substage condenser, the centering and equal distribution over the field of the beam of illumination and the insertion of the funnel stop into the oil immersion objective.

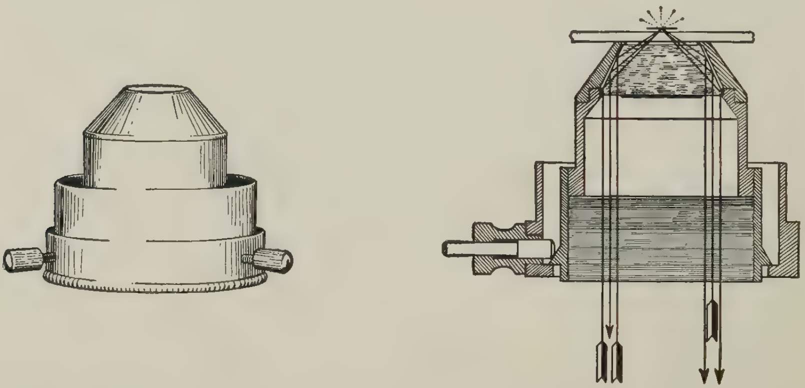

Fig. 591.—Paraboloid condenser. This condenser consists of one optical element, which is a parabolic reflector made of glass having a silvered parabola of revolution as a reflecting surface. It passes out rays of light corresponding to numerical apertures between 1.00 and 1.40; therefore, light only emerges from it if optical contact is made between it and the slide. It is these rays of extreme obliquity which illuminate the object passing into an objective of numerical aperture less than 1.0, only if an object intercepts them and causes diffracted light to enter the objective. Any objective having a numerical aperture less than 1.00 will show as a result brightly illuminated objects on a dark field.

The correct slide thickness of 1.45–1.55 mm. must be maintained in order to insure results.

For successful operation a powerful light source is required, such as direct sunlight, the electric arc, the Mazda, calcium, or inverted incandescent gas lamp.

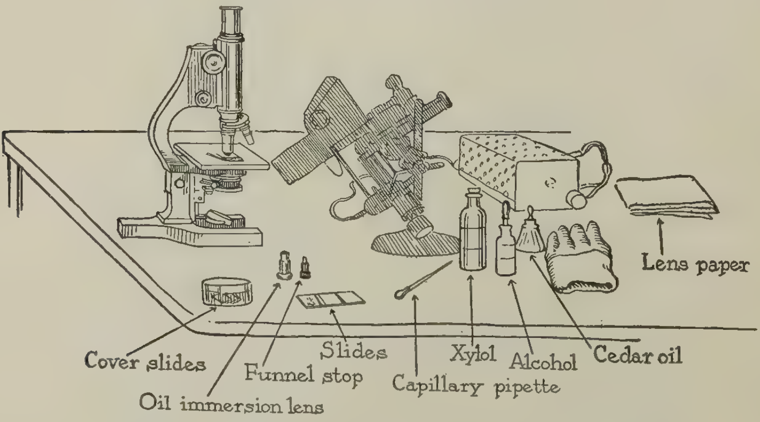

Fig. 592.—Apparatus ready for dark-field examination.

The preparation is made upon a thin glass slide and is covered with a 00 cover glass. If the slide or cover glass is too thick it may be impossible to adjust the illumination and focus satisfactorily. A drop of cedar oil is placed upon the upper surface of the condenser and the slide is laid upon it with the exclusion of air bubbles. A drop of oil is then placed upon the upper surface of the cover glass and upon the oil immersion objective, which is lowered so that the drops of oil meet. The specimen is then examined in the usual manner.

For satisfactory work it is important that the slides and cover glasses should be scrupulously clean and that the objective should not have any dried oil or other dirt on it. Air bubbles in the immersion oil between the top of the dark condenser and the bottom of the slide and between the cover glass and the objective must be strictly avoided.

Examination of the Serum.—After the dark-field apparatus is properly arranged the preparation is made for examination, the patient being recumbent. The cleanest and most recent lesion is selected for study. It is grasped firmly between the thumb and index finger of the gloved left hand and with dry gauze held in the other hand the exudate is rubbed off. The base is rubbed vigorously until there is slight oozing of blood. When a crust is present this should be removed and the underlying ulceration treated as above. The lesion is thus pinched and rubbed several times, then the blood is wiped off and when a good-sized drop of clear serum has exuded on the surface of the lesion, the serum is transferred to the cover slip by means of a small pipet equipped with a nipple. The cover slip is then laid upon a glass slide, serum side down, and the two are pressed firmly together. The specimen is then examined through the oil system, which has been described, plenty of time being taken for the examination of the field. It is bad practice to jump rapidly from one field to another and it is preferable to devote three to five minutes to the study of one field rather than to attempt the study of several rapidly.

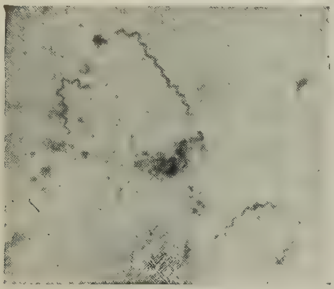

Fig. 593.—Treponema pallidum, preparation from chancre; Giemsa's stain. (Magnification, ×1000.)

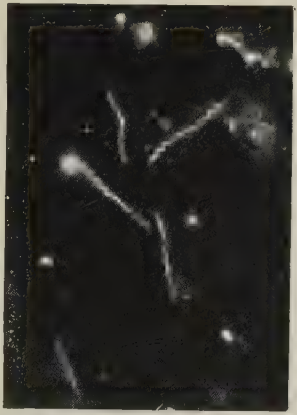

Fig. 594.—Treponema pallidum, pure culture; dark-field view. (Magnification, ×1000.)

(From Hideyo Noguchi, "The Spirochetes," in Jordan and Falk, The Newer Knowledge of Bacteriology and Immunology (1928). Reprinted by permission of The University of Chicago Press.)

Good preparations should contain a few red blood cells but not enough to obscure the field. When there is too much blood one can see little except rouleaux of red blood cells, and when there is too much serum the field is so fluid that it seems to be constantly moving, which makes a steady focus difficult. Somewhat similar defects are caused when the slides or cover glasses are so thick that the objective presses on them. A good preparation should contain five to thirty red blood cells in a field. When the specimen is obtained from a dirty lesion which has been incompletely cleansed, numerous pus cells may be found. These appear as whitish refractile "suns" and with them there are often found cocci and other micro-organisms. The presence of spirochetes in such dirty specimens must be considered dubious until examination is confirmed by specimens obtained from clean lesions or from the draining lymph glands.

The most favorable lesions for examination are those which are of recent appearance, which are clean and which have had no treatment. After the chancre is three weeks old the organisms become progressively less evident on its surface. Treated lesions are frequently impossible to identify by this method. Lesions which are dirty often contain spirilla and the Spirochaeta refringens, which may be confused with the Treponema pallidum. The results of examinations from dirty lesions are always unreliable. Lesions of the lips, mouth, and throat are in the same category and are commonly inhabited by other spirochetes than the Spirochaeta pallida. For this reason the specimen for examination should be obtained by aspiration of the draining glands or of the base of the lesion. Late gummatous lesions are not favorable for examination as the organisms are so scarce that they are not demonstrable by this method. In early lesions which have received no treatment it is usually possible to demonstrate several Treponemata pallida in each field but sometimes only one or two are found in the entire preparation. In the latter case the reliability of the identification must be questioned and further examination should be done to prove the presence of the Treponema pallidum conclusively. The most frequent causes of confusion are the Spirochaeta microdentium and the Spirochaeta refringens, which are not found in the adjacent lymph nodes. The aspiration of these lymph nodes should be done whenever there is doubt about the finding of the Spirochaeta pallida in the sore.

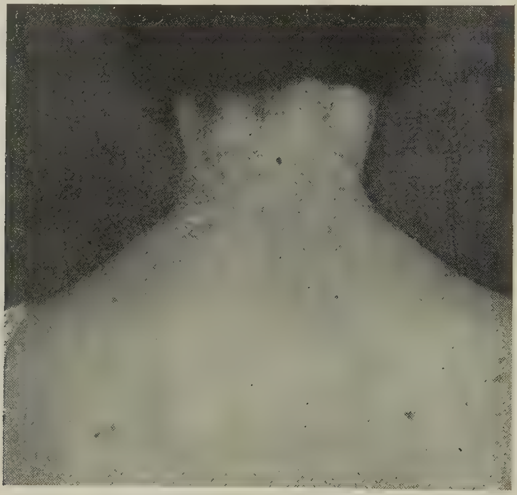

Fig. 595.—Leukoderma colli (pigmentary syphilide.)

Aspiration of Fluid from Lymph Gland.—For aspiration of the lymph glands a tightly fitting tuberculin syringe is attached to a sharp 20-gauge needle, such as is used for intramuscular injections. Three or 4 drops of sterile saline solution are sucked into the syringe, from which the air is expelled. The skin over the gland is painted with iodine and the gland is grasped firmly between the left index finger and thumb. While the gland is thus held steadily, the needle is forced through the skin by the right hand

and through the capsule of the gland. When the needle penetrates the capsule there is a sudden give which can be felt by the right hand. Like an apple on a stick, the impaled gland can be moved about under the skin by means of the needle, which serves as a handle. When it is certain that the gland is pierced, the saline solution is forced into it and the point of the needle is moved about in it so that an emulsion is made of the substance of the gland in the saline solution. The emulsion is then sucked into the syringe by withdrawing the plunger, and when a drop or two have been thus accumulated the needle is withdrawn and a drop is forced upon a glass slide for darkfield examination. The same procedure may be followed in making a puncture examination of the indurated base of a lesion suspected of being a chancre. Local anesthesia may be used but is rarely necessary. The results of such examinations are very satisfactory and give a high percentage of positives.

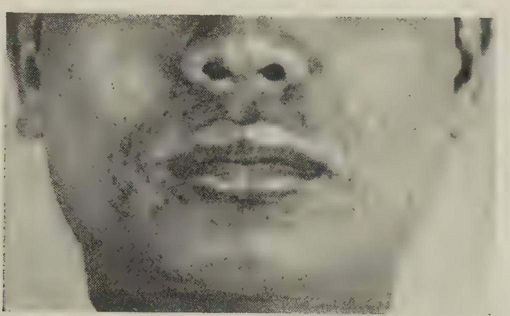

Fig. 596.—Pigmentary lesions about mouth in secondary syphilis. Trimble's sign. (Courtesy of Dr. Mihran B. Parounagian.)

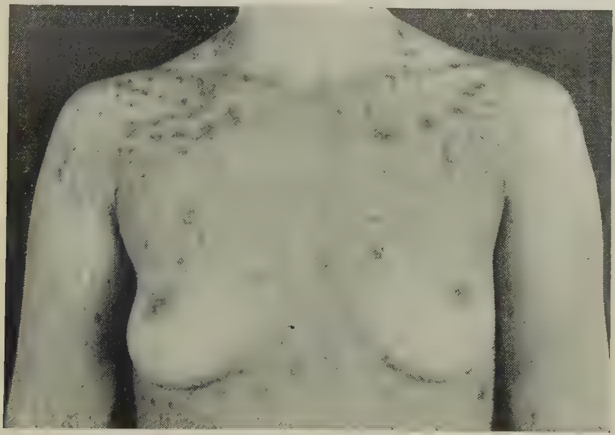

Fig 597.—Maculopapular type of secondary syphilide, with marked pigmentary change around lesions. (Courtesy of Dr. Mihran B. Parounagian.)

Fixed Preparations.—Examination of fixed preparations of treponemata is seldom satisfactory for clinical diagnosis and is most often employed in pathology. Generally spirochetes take stains poorly, but they may be demonstrated in smears by the India ink method or Giemsa's stain and in tissue sections by the silver-impregnation method.

Wassermann Test.—The Wassermann test is the clinical application of the complement-fixation test first described by Bordet and Gengou. It is a qualitative diagnostic test for syphilis and is most commonly performed on the blood serum of suspected syphilitics after removal of cells, but may also be applied to the spinal fluid, extracts and secretions, or exudates and transudates.

Principles.—There are five substances which interact, the mixture of complement, syphilitic amboceptor, and syphilitic antigen composing the antigen system, and the hemolytic amboceptor plus the red blood cells forming the hemolytic system.

1. Complement is a chemical component of blood, which can be destroyed by heating to 56 C. Serum is said to be "inactivated" after such heating. Fresh guinea-pig serum is generally used to supply complement, but in some modifications of the Wassermann reaction the complement present in the patient's serum is employed.
2. Syphilitic amboceptor is an antibody substance which occurs in the serum in syphilis. It is not destroyed by heating to 56 C.
3. Syphilitic antigen, a substance capable of reacting with antibodies, is extracted from syphilitic and certain other tissues. When it is mixed with inactivated (immune) serum in the presence of complement, the complement is fixed by the union of the antigen and the syphilitic amboceptor, so that the complement cannot act in the hemolytic indicator reaction.
4. Red blood cells, obtained from man or animals, are washed and used in a physiologic saline suspension. These red blood cells are acted upon by any unbound complement with the hemolytic amboceptor, undergoing hemolysis, thus indicating a "negative" Wassermann reaction.
5. Hemolytic amboceptor is obtained by immunizing an animal, usually a rabbit, against the red blood cells of sheep or man. As a result of the injection of the red cells into the animal, it develops a specific hemolytic amboceptor. This hemolytic serum (hemolytic amboceptor) does not affect red blood corpuscles in the absence of complement.

When syphilitic antigen is mixed with inactivated immune serum (heated to destroy the complement) the antigen combines with the syphilitic amboceptor (in the blood serum of the syphilitic) to fix the complement (added in the form of guinea-pig complement), so that no complement is free in the mixture. After this mixture has stood at body temperature for an hour, a suspension of red blood cells in salt solution is added together with inactivated hemolytic amboceptor (hemolytic serum); no hemolysis occurs since there is no free complement to complete the hemolytic system. If, however, the patient's blood serum contains no antibody to combine with the antigen used, the complement present is not fixed and is free for the activation of the hemolytic system (red cells plus hemolytic amboceptor) which is added later.

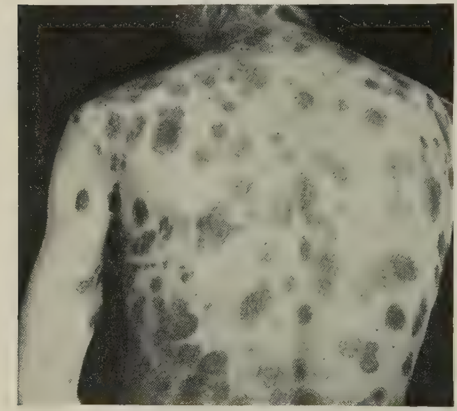

Fig. 598.—An unusual type of annular pigmentary secondary syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

The Wassermann test depends upon the standardization of many variable ingredients. The technic has been largely developed by special laboratories and has become too complicated for employment by the practicing physician. The reaction as described by Rosenau is as follows:

Reagents.—Two antigens are used: one is an alcoholic extract prepared from human heart muscle and half saturated with cholesterin at 17 C., the other is prepared in like manner from guinea-pig hearts. Each of these antigens is diluted with 0.85 per cent salt solution before testing, in the proportion of 4 parts of the antigen extract to 16 parts of 0.85 per cent salt solution. The amount to be used—the dosage—is carefully determined by testing each antigen against a large number of known positive and known negative specimens of blood. Any antigen which gives a positive reaction with a known negative specimen of blood ("false positive") is unsuitable for testing and should be rejected. Further, it is unsafe to employ an antigen when twice its dosage inhibits hemolysis when incubated for one hour with "the hemolytic system" consisting of complement, and the hemolytic mixture.[1] (See Antigen Control in Table on Wassermann Test.) Usually 0.1 to 0.2 cc. of the diluted antigen is used. Lecithin and other lipoidal substances may also act as antigen.

Syphilitic antibody in the patient's serum to be tested is the unknown quantity. This serum is heated in a water bath at 55 C. for thirty minutes to destroy its complement. One-tenth cubic centimeter of the patient's serum is used in the test and 0.2 cc. is used for the serum control. The serum control indicates the presence or absence of inhibiting (anticomplementary) substance other than specific antibodies.

The complement is contained in the serum of freshly drawn guinea-pig's blood which has been kept at 37 C. for one to two hours. A 10 per cent solution of this serum in salt solution constitutes the complement. The amount used in the test is twice the minimum necessary to hemolyze a definite quantity of sensitized cells. Usually this is from 0.4 to 0.5 cc. of the complement.

Washed corpuscles are prepared from freshly obtained defibrinated sheep's blood. In order to free the corpuscles of serum, the blood is washed three times with from four to five volumes of physiologic salt solution at each washing. Finally the volume of cells and salt solution is made equal to the volume of defibrinated blood originally used. Such a suspension is called washed sheep's corpuscles from which the 5 per cent suspension for the test is prepared.

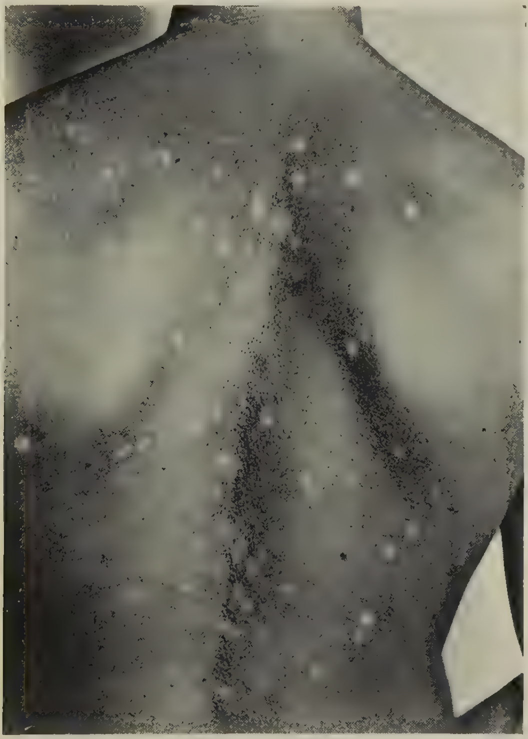

Fig. 599.—Depigmentation following secondary syphilide in a negro.

Immune rabbit's serum is prepared by injecting washed sheep's corpuscles into the peritoneal cavity of a rabbit at three-day intervals, namely, first injection, 7 cc.; second, 14 cc.; third, 21 cc., and finally 28 cc. The rabbit is bled on the ninth or tenth day after the last injection and the clear serum obtained from its blood is heated in a water bath at 55 C. for one-half hour to destroy complement. This heated rabbit's serum contains the amboceptor and is diluted with 0.85 per cent salt solution, so that 0.25 cc. will hemolyze 0.5 cc. of a 5 per cent suspension of sheep's corpuscles. In the test 0.5 cc. of the diluted amboceptor is used. A small quantity of the rabbit's serum is freshly diluted for each day's test.

The *hemolytic mixture,* or *sensitized cells,* consists of equal parts of a 5 per cent suspension of washed sheep's corpuscles and the diluted amboceptor which have been incubated together in a water bath at 37 C. for one-half hour to sensitize the red corpuscles completely. One cubic centimeter of sensitized cells is used in the test.

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[1] Also known as sensitized red blood cells.

The Test.—Mix the patient's serum or spinal fluid with the antigen and the complement, according to the table on page 702. The tubes are well shaken and the whole is incubated at 37 C. for forty minutes. At the end of this time all of the complement has been fixed in those tubes which contain syphilitic antibody, antigen, and complement. Finally, 1 cc. of sensitized cells is added to each tube and the whole again incubated at 37 C. for one hour. The results of the Wassermann test are then read.

The absence of hemolysis indicates the presence of syphilitic antibody in the patient's serum, and therefore a positive reaction. The presence of hemolysis indicates the absence of syphilitic antibody in the patient's serum, and therefore a negative reaction. Partial hemolysis signifies a doubtful reaction. It is advisable to test several specimens from such a case, and to interpret a persistently or predominatingly doubtful reaction as indicative of a syphilitic infection.

The tests are usually estimated as plus-minus or doubtful, and one, two, three, or four plus reactions, the +++ and ++++ representing strongly positive tests. The partial inhibitions are the weak positive Wassermann tests. A high degree of technical accuracy is necessary in the handling of the reagents. The specimen must be free of bacterial contamination, deterioration, and anticomplementary substances.

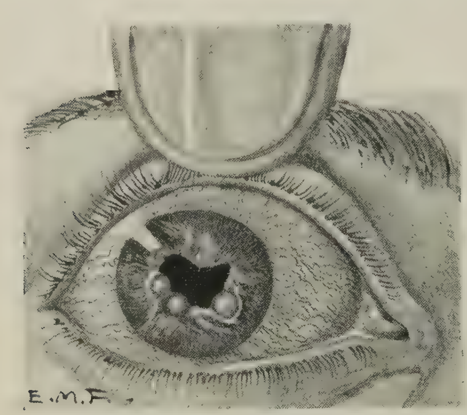


Fig. 600.—Syphilitic iritis. Note circumcorneal congestion and irregular dilatation of pupil. There are four yellowish-red papules on the pupillary border of the iris. (Courtesy of Dr. Conrad Berens.)

Interpretation of Results.—Repetition of the test is an important check in clinical diagnosis. As Stokes points out, "Repeated strongly positive Wassermann tests (two or more), especially if separated by an interval of several days, are almost incontrovertible evidence of syphilitic infection in the absence of a condition definitely known to give a nonspecific positive. Repetition of the test is one of the best methods of eliminating technical errors." Moreover, because of positive reactions or partial positives in cases of other diseases as yaws, tuberculosis, pernicious anemia, malaria, and other conditions known to give nonspecific positive reactions, a diagnosis of syphilis should not be made on the basis of a single positive blood Wassermann unsupported by other strong evidences of the disease. During the period from about three weeks after the chancre has appeared to the peak of secondary manifestations (about a half year) the Wassermann test has its highest positive efficiency. With prolonged treatment some cases still show positive tests, especially in the intermediate or late stages in those who have not had enough treatment at the beginning. Such reactions may be due to the presence of active lesions somewhere, although clinically there are no evidences of the activity of the disease. Slight fluctuations in the Wassermann test are of frequent occurrence in some cases even without treatment. Negative Wassermann tests cannot be dismissed lightly. The single negative blood reaction cannot be accepted as excluding syphilis from diagnosis, but only as one element. Stokes says "from one fifth to one half the syphilis which an average clinican sees will present itself with negative Wassermann credentials, and will have to be recognized by other means or go undetected."

Modifications of the Wassermann Technic.—Many modifications of the Wassermann reaction have been introduced with the aim of increasing the sensitiveness and reliability of the test. The modification of Noguchi consisted in the substitution of human red blood cells and hemolytic amboceptor prepared against them, for the sheep cells and antisheep serum used in the original method. Noguchi also used a strong antigen prepared by precipitating the crude alcoholic extract of beef heart with acetone and redissolving the precipitate in ether and alcohol. This antigen has been used also by other workers. The Hecht-Weinberg modification makes use of the antisheep amboceptor in complement normally present in human serum. The serum is tested without preliminary heating and unsensitized sheep cells are added in the second stage of the reaction; this increases the sensitiveness of the test, but, according to many observers, introduces nonspecific reactions. Another modification used by many workers is incubation during the first stage of the reaction for four to twenty-four hours in the ice-box instead of for one hour at 37 C.; this seems to increase the sensitiveness of the test. With simple alcohol extracts the results obtained are satisfactory but with cholesterin extracts the reaction has been found by most observers to be oversensitized. Kolmer has introduced a modification, which is widely employed. The reagents used are the same as in the Wassermann test here described but the standardization of the reagents is more elaborately carried out and the reaction is set up with varying amounts of serum so as to give a quantitative reading.

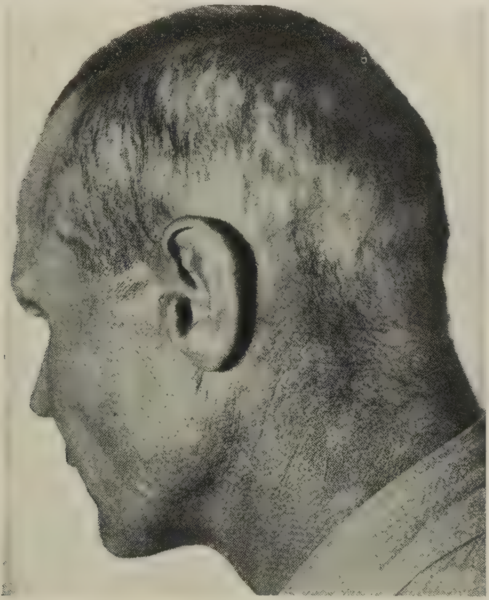


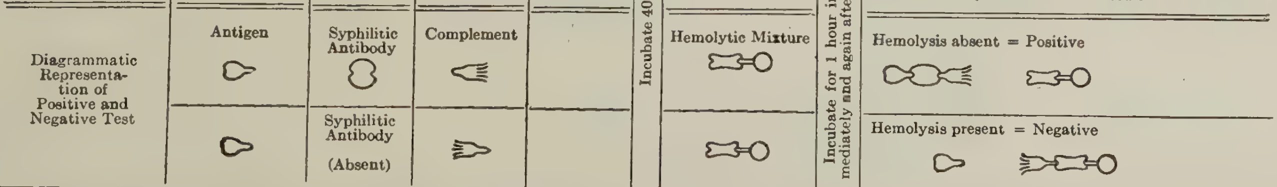
Fig. 601.—Syphilitic alopecia of scalp, showing the typical "moth eaten" appearance.

Precipitation Tests.—The fixation of complement in the Wassermann reaction probably depends upon the formation of a minute precipitate by which the complement is absorbed. Many methods have been introduced to make this precipitate visible and enable the reaction to be performed without the use of the hemolytic system.

The Serological Conference of 1928 sponsored by the League of Nations concluded after exhaustive study that the precipitation tests developed during the last few years are a tremendous advance in specificity and sensitivity over the complement fixation tests for syphilis. "The Kahn test and the Müller clotting test entirely outclass in sensitivity the Wassermann procedures considered, apparently without loss of specificity. On the score of specificity the Kahn and the Sachs-Georgi lead the nearest Wassermann competitor, the British Medical Research Council Method No. 1, by a substantial margin. Taken all in all, the performance of the Kahn test is

WASSERMANN TEST

	Number of tube	*Antigen* Alcoholic extract of human heart cholesterinized *	*Antibody* *Patient's Serum* heated 55°C for 30 minutes **	*Complement* Guinea-pig serum 10% †	*Saline Solution* 0.85%	Incubate 40 minutes in water bath at 37° C.	*Hemolytic Mixture* 5% suspension of sheep's corpuscles + heated rabbit's immune serum (amboceptor) §	Incubate for 1 hour in water bath at 37° C. Note results immediately and again after having kept in ice box for 12 to 14 hours.	Result
Antigen Control	I	0.2 c. c.	0.0 c. c.	0.5 c. c.	0.8 c. c.		1.0 c. c.		Hemolysis should be complete
Serum Control	II	0.0	0.2	0.5	0.8		1.0		Hemolysis should be complete
Serum Test	III	0.1	0.1	0.5	0.8		1.0		No Hemolysis = syphilitic antibody in patient's serum (Positive) Hemolysis = absence of syphilitic antibody in patient's serum (Negative) Partial Hemolysis = Doubtful result


Diagrammatic Representation of Positive and Negative Test
Antigen
Syphilitic Antibody
Complement
Hemolytic Mixture
Hemolysis absent = Positive
Syphilitic Antibody
(Absent)
Hemolysis present = Negative

For routine tests the positive serum of a known syphilitic, the negative serum of a non-syphilitic and each of the serums (or spinal fluids) to be tested are set up according to tubes No. II and No. III, together with one antigen control according to tube No. I.

* The dilution is made so that 0.1 c. c. contains one-half the maximum amount or less than one-half the maximum amount which does not inhibit hemolysis. A carefully standardized alcoholic extract of human heart muscle, half-saturated with cholesterin, usually gives a superior antigen. (See text.)

** Use five times the quantity of spinal fluid not heated.

† Five-tenths cubic centimeter contains two units, as determined against the hemolytic mixture.

§ The amount of immune rabbit's serum in each c. c. of this mixture is twice that necessary to hemolyze 0.5 c. c. of a 5% suspension of sheep's cells in the presence of 0.5 c. c. of 10% complement.

Fig. 602.—From Rosenau, M. J.: Preventive Medicine and Hygiene, D. Appleton & Co., New York.

outstanding and places it as among the best, if not the best, serodiagnostic procedure in the syphilology of the present day. Again it must be said with regret that circumstances prevented Kolmer from being present at so genuine a trial of strength. The conference wisely endorsed a conclusion that will appeal to the majority of syphilologists who must interpret the disease to the patient in the clinic—that for the time being more than one procedure, and preferably one complement-fixation and one precipitation test, be performed on every blood that is being studied for evidence of the presence of syphilis. The large margin of nonspecific reactions, ranging from 1.4 to 10.4 per cent, obtained with Wassermann modifications that do not differ essentially from tests in common and exclusive use in the laboratories of this country, indicates that many patients are today being sentenced, the world over, to treatment for syphilis on insufficient and untrustworthy evidence."[1]

In the method of Sachs-Georgi a specially prepared alcoholic extract of heart muscle with cholesterin is allowed to stand with the patient's serum overnight and readings directly made of the precipitate formed. In the sigma reaction of Dreyer and Ward a strong antigen of similar composition is tested with serial dilutions of serum. The reaction is quantitative. It is tedious to perform and requires some practice in reading but the results are apparently accurate. It has been widely used in England but little in this country.

The Vernes reaction consists of incubating the serum with the antigen by a carefully standardized technic and reading the opacity of the mixture by means of a nephelometer specially designed for this purpose called the "photométre." Meinecke has introduced several methods for determining the precipitating power of syphilitic serums. His last modification, which employs an antigen made of alcoholic extract of beef heart and balsam of Tolu, gives very sharp readings, a positive result being indicated by a complete clearing of the cloudy mixture on account of precipitation of the lipoid and gum.

Of all the precipitation methods, the reaction described by Kahn is the simplest and has achieved wide acceptance in this country. It has the advantage of speed, as well as simplicity, and the reactions can be read within a few minutes after the mixtures of serum and antigens are prepared.

Kahn Test.—The Kahn test is a precipitation method for detecting syphilitic serum by means of a specially prepared antigen. With this antigen of proper lipid concentration, a suspension is formed with the addition of salt solution which produces immediate precipitation reactions with syphilitic serum. Incidentally, the Kahn precipitation reaction has been found to be positive and to have the same value as the Wassermann reaction in the serum diagnosis of yaws. The technic given is from Kahn's recent work on the test.[2]

Reagents.—Performance of the Kahn test requires the use of three reagents: blood serum, physiologic salt solution, and antigen.

1. Blood serum. Five cc., if possible, is collected into a clean sterile glass tube. With the tube in a slanted position, giving the blood a larger surface exposure, it is allowed to coagulate with the avoidance of extreme heat or cold, which hastens hemolysis. The serum is freed from corpuscles or visible particles of any kind, or if clear the supernatant serum is removed with a chemically clean bulb-capillary pipet, and is then heated for thirty minutes in a water bath at 56 C. before the performance of the test.
2. Physiologic salt solution.
3. Antigen. In the preparation of antigen from powdered beef heart three reagents are employed: ether, alcohol, and cholesterol. "The fat-free muscles from three or more beef hearts are finely ground by passing them three or four times through a meat chopper. The resulting meat paste is spread into a thin layer on a porcelain platter or glass plate and

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[1] Stokes, J. H.: Some Recent Aspects of International Cooperation in Syphilologic Research, Arch. Dermat. and Syph., 21: 212–213, Feb., 1930.

[2] Kahn, R. L.: The Kahn Test, Baltimore, Williams & Wilkins Co., 1928.

dried by means of one or two electric fans. When the surface has become somewhat dry, after about six hours' exposure to the fans, the material is turned over and drying is continued overnight. The dried material is broken up into small pieces, covered with cheesecloth, and the drying is further continued until the small particles are brittle. The particles are powdered by grinding in a mortar or in a coffee grinder reserved for this special purpose. Powdered beef heart for preparing antigen is now obtained on the market in the form of Bacto Beef Heart." In Kahn's experience, the market preparation gives highly uniform results.

Further preparation of the antigen is given in the following brief form by Kahn.

Outline of Standard Method for Preparing Antigen from Powdered Heart Muscle

Ether extraction:	(1) 25 Gm. powder in 250 cc. Erlenmeyer flask—100 cc. ether added. Flask shaken intermittently for ten minutes to keep powder in suspension. Mixture filtered. Gentle pressure exerted on mixture by means of spatula until practically no ether drops from funnel. (2) Moist powder returned to flask—75 cc. ether added. Mixture shaken ten minutes and filtered as in (1). (3) Moist powder returned to flask—75 cc. ether added. Mixture shaken ten minutes and filtered as in (1). (4) Moist powder returned to flask—75 cc. ether added. Mixture shaken ten minutes and filtered as in (1). Powder dried until free from ether odor.
Alcohol extraction:	Powder weighed and returned to flask used above (after flask has been completely dried). 5 cc. alcohol (95 per cent) added per gram of powder. Mixture shaken ten minutes. Extracted three days at room temperature (21 C.) in the dark without shaking. Mixture shaken five minutes before filtration. Filtration of mixture: Choice of two methods. (1) In the same manner as ether extractions. (2) Filtration by suction. Precaution: (In order to avoid affecting the antigen by undue evaporation of alcohol.) Maximum length of filtration period: 25 Gm. of beef heart under five minutes. 200 Gm. of beef heart under fifteen minutes. Apparatus: (*a*) Suction flask (size adjusted to amount of antigen being prepared). (*b*) Buchner funnel (size adjusted to amount of antigen being prepared). (*c*) Rubber stopper for flask perforated to fit stem of funnel (stopper should be covered with several layers of tinfoil). (*d*) Pressure hose, connected to suction. (*e*) Filter paper cut to fit Buchner funnel. Filtered extract kept as stock solution in dark at room temperature.
Addition of cholesterol:	6 mg. of cholesterol added per cubic centimeter of alcoholic extract. (1) Cholesterol for 100 cc. of antigen to be weighed on scales accurately to within 1 or 2 mg. (2) Placed in Erlenmeyer flask of at least twice the volume of antigen to be cholesterolized. (3) Required amount of antigen added to flask. (4) Cholesterol dissolved by placing flask in water bath or by gently rotating flask under warm tap water. (5) Cholesterolized extract filtered, and ready for standardization. (Cholesterol may be added to an amount of alcoholic extract sufficient for several months' use.)

The antigen is then standardized by titration to render it comparable in specificity and sensitiveness to standard antigen. This is done by the determination of the minimum

TABLE 31

Typical Antigen Titration for Serum Tests

		Antigen + physiologic salt solution, cc.														
A. *Preparation of antigen suspensions:*																
Antigen mixed with salt solution in different proportions		1 + 0.7			1 + 0.9			1 + 1.0			1 + 1.1			1 + 1.2[1]		
Appearance of mixtures		Heavy suspension of aggregates.			Heavy suspension of aggregates.			Heavy suspension of aggregates.			Heavy suspension of aggregates.			Heavy suspension of aggregates.		
B. *Test for dispersibility of aggregates:*																
Each suspension, after standing 30 minutes, is tested with salt solution in three proportions (cf. 3-tube Kahn test)	Tube number	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
	Antigen suspension, cc.	0.05	0.025	0.0125	0.05	0.025	0.0125	0.05	0.025	0.0125	0.05	0.025	0.0125	0.05	0.025	0.0125
	Salt solution, cc.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Tubes are shaken 3 minutes and salt solution added to each	Salt solution, cc.	1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5
Appearance of mixtures		Cloudy (visible aggregates present).			Cloudy (no visible aggregates present).			Cloudy cloudy clear (opalescent and no visible aggregates present).			Opalescent and clear. Titer (1 + 1.1).			Opalescent and still clearer.		

[1] When still higher proportions of salt solution are used the suspension is less dense, and eventually changes to an opalescent mixture.

volume of salt solution to be added to a given volume of antigen which will cause the formation of lipid aggregates that are capable of becoming completely dispersed upon the further addition of salt solution. Then correction is made to the standard required (Table 31—Typical Titration).

Performance of Test.—1. *Preparation of Standard Antigen Suspension.*—Mix antigen with physiologic salt solution according to required titer. Thus, if the titer is 1 cc. antigen plus 1.1 cc. salt solution, mix the antigen as follows:

Measure 1.1 cc. salt solution into a standard antigen suspension vial.

Measure 1 cc. antigen into a similar vial.

Pour the salt solution into the antigen, and as rapidly as possible (without waiting to drain the vial) pour the mixture back and forth six times to insure thorough mixing.

Allow the antigen suspension to stand for ten minutes before using. The suspension should not be used after thirty minutes' standing.

One may mix more than 1 cc. of antigen with a proportionately larger amount of salt solution, but not less than 1 cc. This amount when mixed with salt solution will be sufficient for about 15 tests. Two cubic centimeters of antigen mixed with salt solution will be sufficient for about 35 tests.

2. *Measuring Antigen Suspension.*—After the antigen suspension has stood for ten minutes, shake it well (closing the mouth of the vial with the thumb) and measure 0.05, 0.025, and 0.0125 cc. amounts for each serum, delivering the suspension to the bottom of the tubes. When employing the standard rack which contains 30 tubes, measure 0.05 cc. amounts in the tubes of the first row; 0.025 cc. amounts in the tubes of the second row and 0.0125 cc. amounts in the tubes of the third row.

3. *Measuring Serum.*—The serum should be added as soon as possible after the antigen suspension has been pipetted, to avoid undue evaporation from the suspension. When examining large numbers of sera, it is well for one worker to measure the antigen suspension and for another to follow with the sera. Add 0.15 cc. serum to each of the 0.05, 0.025, and 0.0125 cc. amounts of antigen suspension, and shake the rack of tubes vigorously for about ten seconds (by hand) to insure thorough mixing of the ingredients. The rack may now be set aside until a given number of tests—up to about sixty—is ready for the regular three-minute shaking period.

4. *Controls for Each Series of Tests.*—Antigen control. When pipetting antigen suspension for a series of tests, use the last set-up of 0.05, 0.025, and 0.0125 cc. amounts as controls—adding to each tube 0.15 cc. salt solution instead of serum. Include with the regular tests. All three tubes should show freedom from precipitation.

Serum control. Examine each serum for particles which might give the appearance of a specific precipitate. It is essential to determine particularly in the case of positive reactions that the serum used in the test is entirely clear. In such reactions it is well to dilute the serum with salt solution to correspond approximately to the final dilution of serum when the tests are read. The dilution of the serum may render visible fine particles which are invisible in undiluted serum. Method: Dilute 0.1 cc. serum with 0.3 cc. salt solution; shake tube for three minutes and examine for particles. If particles are present, the serum should be cleared by centrifugation and retested.

Positive and negative controls. Include one or more sera which are known to give positive reactions and a similar number of sera giving negative reactions with each series of tests.

5. *Shaking.*—The standard shaking period is three minutes. It is important not merely to agitate the rack of tubes but to see that the fluid within the tubes is vigorously agitated. When the tests are shaken by hand, one may shake each rack for three-minute periods with short rest periods. When a shaking apparatus is employed, its speed should be not less than 275 oscillations and not more than 285 oscillations per minute, with a stroke of 1.5 inches. When shaking by hand, this speed should be approximated.

6. *Addition of Salt Solution.*—After the serum-suspension mixtures have been shaken, add 1 cc. salt solution to each tube of the first row of the rack (containing the 0.05 cc. amounts of antigen suspension) and 0.5 cc. salt solution to the remaining tubes. Shake sufficiently to mix ingredients.

Interpretation of Results.—The results in the individual tubes are read on a plus sign basis. The interpretation is also on this basis. When each of the three tubes shows four plus precipitation, the final result is interpreted as a four plus reaction. When some of the tubes show weak or negative precipitation, such as negative in the first tube, two plus in the second tube, and four plus in the third tube, the final result is interpreted as a two plus reaction. In other words, the final result is the average of the findings of the number of plus signs represented by the three tubes. If, after averaging, the final result contains a fraction of one plus, then, if the fraction is one third, it is disregarded; if the fraction is two thirds, it is counted as an additional plus sign. Examples: ++, ++++, ++++ is interpreted as a three plus reaction, and +, +++, ++++ is also interpreted as a three plus reaction. When precipitation in an individual tube is read doubtful (±), it is not taken into consideration in averaging, but is counted as negative. Thus, ±, +, +++ is interpreted as a one plus reaction (4 plus divided by three = one plus). For reasons of conservatism, very weak reactions, *i. e.*, those in which precipitation is limited to the third tube, no result is averaged unless this tube shows at least a two plus precipitate. Thus −, −, ++ is interpreted as a doubtful (±) reaction. When the results in the three tubes are −, ±, +, the reaction is interpreted as negative. It might be added, however, that even the latter reactions have been found to be highly specific for syphilis.

Examination of the Cerebrospinal Fluid.—The neurological and systemic effects of syphilis are a field beyond the domain of this book, but examination of cerebrospinal fluid is a routine procedure in almost every case of syphilis. Alterations in the spinal fluid in syphilis are detected by changes in the cell count, the quantitative Wassermann reaction, the globulin content, and colloidal tests with gold, benzoin, or mastic. The pressure of the fluid, its color, and other physical properties should be noted at the time of withdrawal. Normally it is clear and colorless like water. If hemorrhage has been caused by introduction of the needle or by previous trauma, it has a reddish or brownish tinge, and xanthochromia occurs in some spinal neoplasms. Slight hemorrhages may be insufficient to alter the color and yet great enough to influence the globulin tests. Changes in pressure are present in many diseases. Increases, with spurting or rapid dropping, are signals that the stylet should be replaced within the needle so that the flow can be carefully regulated. Too rapid withdrawal of fluid may otherwise precipitate a serious condition resembling shock. Reduction in the rate of flow is usually caused by some obstruction of the opening of the needle by the pia.

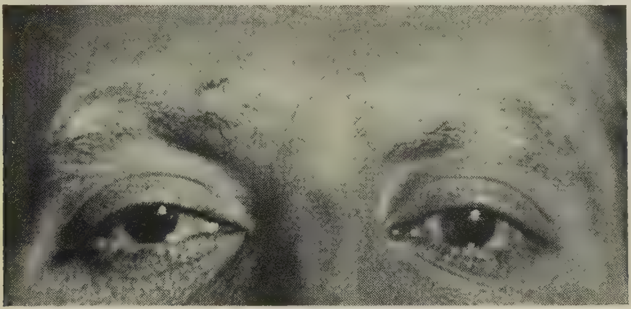

Fig. 603.—Alopecia of the eyebrows in secondary syphilis. (Courtesy of Dr. Samuel Kaufman.)

Cell Count.—The cells should be counted immediately after withdrawal of the fluid, as delayed cell counts are inaccurate. If there has been any bleeding, errors in the count of leukocytes are necessarily so large that the count is worthless even with the addition of acetic acid or other agents for laking the erythrocytes. The cells may be counted without staining or may be stained with a special solution. The pipet is the same as that used for counting leukocytes. This is washed out with glacial acetic acid, and is filled with the cerebrospinal fluid, the latter having first been shaken. Two drops are discarded and the third is placed upon an ordinary blood cell counting chamber. It is examined with the high-dry objective. The cells in nine squares are counted, and their number is multiplied by ten and divided by nine to give the average number of cells per cubic millimeter. As the squares on the counting chamber are 1 mm. wide, their surface area 1 sq. mm., and they are 1/10 mm. deep, ten of them form 1 cubic millimeter.

Unna's polychrome methylene-blue solution may be drawn up to 1 on the blood pipet, and the bulb then filled with spinal fluid, freshly shaken, to 11.

The fluid is thoroughly mixed with the stain by shaking the pipet from three to five minutes. The count should be made in a Fuchs-Rosenthal chamber immediately, the first drop from the pipet being discarded. A proper-sized drop is placed upon the plateau of the chamber, care being taken that the drop is both large enough to cover the entire ruled field and small enough to remain on the plateau without spreading into the groove when the cover slip is added. After the mixture has been placed upon the stage of the microscope, a minute is allowed for the cells to settle. The number of leukocytes per cubic millimeter is estimated by counting the whole 16 sets of 16 squares. To obtain the number per cubic millimeter the total number is multipled by 11 and divided by 32, *i. e.*, multiplied approximately by 0.3. It is advisable to count two or three slides and take the average.

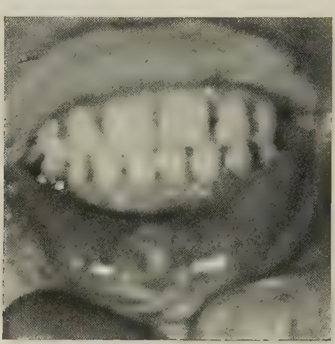

Fig. 604.—Dorsum of lower lip.

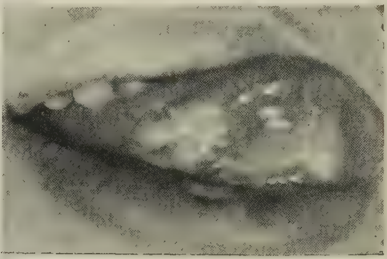

Fig. 605.—Under surface of tongue.

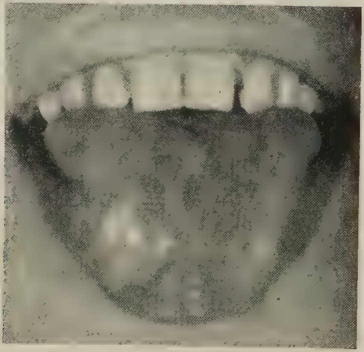

Fig. 606.—Upper surface of tongue.

Figs. 604–606.—Mucous patches of the mouth. (Courtesy of Dr. A. M. Davidson, Winnipeg, Canada.)

Interpretation.—The cell count is an index of the meningeal reaction to the disease. Normal spinal fluid contains 1 to 10 lymphocytes per cubic millimeter, although counts between 1 and 5 are more definitely normal than those between 5 and 10, to which latter some suspicion should be attached. Counts above 10 are abnormal. Counts within the normal limits are found in neurosyphilis, especially of the vascular type, even in the presence of a strongly positive spinal Wassermann test. Cell counts between 20 to 100 are not infrequent in tabes and paresis, in which the parenchymatous changes are associated with some meningeal involvement. The greatest increase in cells is seen in syphilitic meningitis during the secondary stage, counts ranging from 200 to 1500.

Colloidal Gold Test.—The colloidal gold test, also called the gold sol test, shows the amount and physical state of the globulin in the spinal fluid. The test is difficult to perform, and the results vary according to the state of the reagents—dirty glassware and other incidental factors. The test was devised by Lange in 1912. Following is a general description of the technic, which, however, is variously modified by different laboratories.

Technic.—Four solutions are prepared: (1) A 1 per cent gold chloride solution in very carefully distilled water, absolutely clean utensils being used throughout; (2) a 2 per cent potassium carbonate solution; (3) a 1 per cent formaldehyde solution, and (4) a 10 per cent sodium chloride solution. These solutions may be kept in stock and are used from time to time to make up the indicator.

Preparation of the Gold Solution.—Into a 1000-cc. flat-bottom flask of best Jena glass, place 500 cc. of freshly and doubly distilled water. The apparatus used for the distillation should not have rubber connections in contact with the steam or with the water.

Add to the water warmed to 60 C., 5 cc. of the carbonate solution and place on a wire gauze for rapid boiling. A half minute after the addition of the carbonate solution, add 5 cc. of gold chloride solution and permit the mixture to boil up quickly, two burners being used. As soon as the first bubbles of ebullition appear, remove the flask from the flame and gradually add 3¾ cc. of the formalin solution; shake the mixture constantly in a rotary fashion until the fluid becomes a deep cherry red. To test the color, place 15 cc. of N/10 sodium hydroxide solution in an ordinary test tube, add 0.2 cc. of 5 per cent Congo red solution and 0.3 cc. of 1 per cent alizarin solution. The intensity and nuance of the color of the solution as viewed by transmitted light correspond exactly to the depth and color of the indicator in the flask, viewed in a similar way. The resulting solution should be absolutely clear, should not give rise to a bluish deposit on the vessel after standing for a few days, nor should it have a yellowish shimmer. It keeps for a few weeks, but a fresh solution is preferable.

At the time of making the test a 0.4 per cent solution is freshly prepared from the 10 per cent sodium chloride by taking 4 cc. of the latter and making it up to 100 cc. with double distilled water.

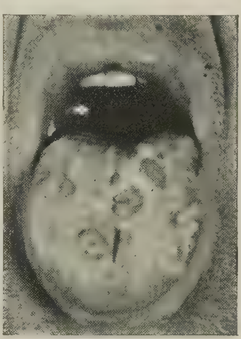

Fig. 607.—Superficial glossitis in secondary syphilis. Note the sharp demarcation of the lesion and one area of fissuring. (Courtesy of Dr. Mihran B. Parounagian.)

Performance of the Test.—Into the first of ten test tubes place 1.8 cc. of the salt solution, and in each of the other nine, 1 cc. Then add to tube No. 1, 0.2 cc. of cerebrospinal fluid, mix and remove 1 cc. of the fluid, which is placed in tube No. 2. Continue the procedure until each tube receives a gradually weaker dilution of the spinal fluid. Now add to each tube 5 cc. of the gold solution indicator and mix well at once. Let the tubes stand for twenty-four hours at room temperature.

Interpretation.—Positive reactions are indicated by variations in the shades of color due to differences in precipitation. The original color being red is given the designation 0 and the following alterations in tint lie between it and the colorless; completely positive result, known as 5, which is due to total precipitation; reddish blue, 1; bluish red, 2; blue, 3; faint violet, 4. The shade of color in each of the ten tubes is indicated by the appropriate numeral. A completely negative reaction is expressed by 0000000000. Minor changes which are of an indeterminate character are those in which no numerals higher than 2 are present (0001122100, for example). The positive types of tests are unfortunately designated as "paretic curves" and "luetic curves." Their specific prognostic value is not reliable. Paretic curves are high at the left in the first zone, for instance, 5554432100, whereas the luetic curves are high in the middle or second zone, for instance, 0123432210. Curves in the third zone, high at the right, occur in tuberculous and septic meningitis and have no relation to syphilis. Only curves in the first and second zones have value in the diagnosis of syphilis. The most important of these is the strong paretic curve 5555555430, or a weaker paretic curve, 4543321000, when occurring simultaneously with a strongly positive Wassermann reaction; and especially when it persists in spite of treatment, this curve may have some significance in prognosis. However, a paretic curve in the absence of physical signs may not indicate that a patient has or will develop paresis. It seems that patients with a paretic curve respond less readily to treatment. At times syphilitic meningitis will give similar curves but these disappear after adequate treatment. The substitution of a luetic curve for a paretic curve is sometimes a favorable sign and is indicative of the diagnostic unreliability of the paretic curve.

Multiple sclerosis gives a strong curve in the first zone with a completely negative Wassermann reaction. Luetic curves are more susceptible to influence by treatment than curves in the first zone due to paresis. However, curves in the second zone do not exclude paresis.

With treatment it is usually possible to reduce the intensity of the colloidal gold test. Fluctuations are often of a temporary nature and are not important. A completely negative (0000000000) colloidal gold test is the aim of treatment, and this often occurs only subsequent to the reversal of the other spinal fluid tests.

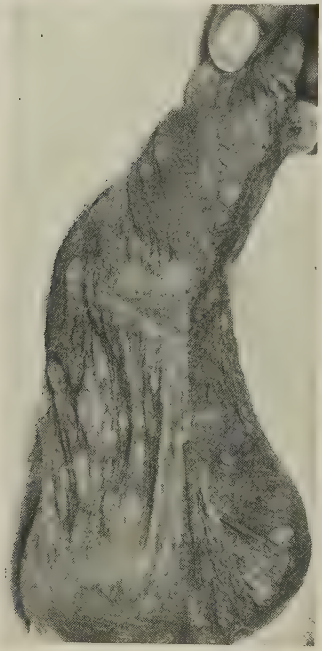

Fig. 608.—Papulosquamous secondary syphilide of scrotum and penis. (Courtesy of Dr. Mihran B. Parounagian.)

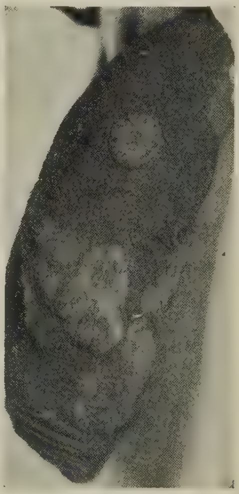

Fig. 609.—Circinate confluent papules on shaft of penis in case of secondary syphilis. (Courtesy of Dr. Mihran B. Parounagian.)

Globulin.—Tests for the amount of globulin in the spinal fluid have no specific diagnostic value but serve to supplement other findings. An increase of globulin occurs in all inflammatory diseases of the central nervous system. The test is positive regularly in the cerebrospinal fluid of cerebrospinal syphilis and also in all cases of inflammation of the meninges caused by such organisms as meningococcus, pneumococcus, bacillus of influenza, tuberculosis, *et cetera*, and in poliomyelitis. In cases under treatment the globulin test often remains positive after the other findings have become negative, and in such an instance the test may serve as an indication for further treatment. The following tests to estimate globulin, as well as the Pandy, are in common use.

Noguchi Butyric Acid Test.—The test can be performed only with cerebrospinal fluid entirely free from blood. Two parts of the cerebrospinal fluid are mixed with 5 parts of a 10 per cent solution of butyric acid in physiologic salt solution and are boiled for a brief period. One part of a normal solution of sodium hydroxide is then quickly added to the heated mixture, and the whole boiled again for a few seconds. The actual quantities of these three reagents that Noguchi preferred are 0.1 or 0.2 cc. of cerebrospinal fluid, 0.5 cc. of butyric acid solution and 0.1 cc. of the normal sodium hydroxide.

Normal cerebrospinal fluid gives a slight opalescence and sometimes a marked turbidity, but no granular precipitate, unless after standing several hours.

The presence of an increased content of protein is indicated by the appearance of a granular or floccular precipitate, which gradually settles to the bottom beneath a clear supernatant liquid. The velocity and intensity of the reaction vary according to the amount of protein present, one hour being required in a weak content.

Ross-Jones Cerebrospinal-fluid Test.—This is a ring test, ammonium sulphate being used as the precipitating agent. Carefully float 1 cc. of cerebrospinal fluid over 2 cc. of concentrated ammonium sulphate solution. When an opalescent ring of hairlike fineness results after three minutes, the reaction is considered as signifying a globulin excess.

PROPHYLAXIS

Prophylaxis involves judicial, medical, and personal effort. The judicial phase is outside the scope of this book. Many physicians unfortunately give inquiring young men extremely poor advice concerning the important matter of intercourse. Continence is compatible with good health and is later appreciated by the partner in case of marriage. Avoidance of all forms of dissipation is helped greatly by regular physical exercise and such a practice should be urged by the physician upon the numerous young men who ask, "Doctor, is there anything I can do to protect myself?" What is best and what is practicable are not always in agreement. If there is to be exposure, for all who are unmarried the condom is, from the standpoint of health and social obligation, an absolute necessity. Although it is true that these rubber protective articles do not avoid the risk of extragenital contamination, they are the most practicable means of prevention of infection through sexual intercourse and at the same time act as the best contraceptive. The most effective medical prophylactic is 33 per cent calomel ointment, which may be purchased in little collapsible tubes that also contain small amounts of phenol and camphor from any druggist if a prophylactic

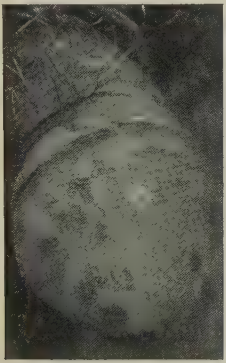

Fig. 610.—Secondary syphilitic eruption of small papules of glans penis. (Courtesy of Dr. Mihran B. Parounagian.)

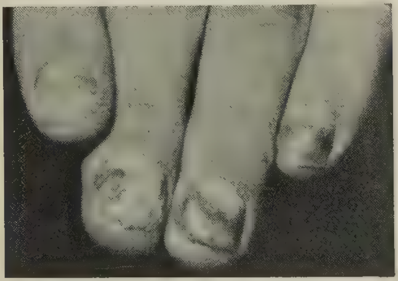

Fig. 611.—Syphilitic involvement of nails with atrophy and deformity in a case showing secondary lesions on the body. (Courtesy of Dr. Edward A. Oliver.)

is asked for. Medical prophylaxis within one hour after exposure is extremely effective. Whenever possible this prophylaxis should be given by a physician rather than by the patient himself. Soap in itself is an important preventive agent, and soap and water should be freely used immediately before and immediately after contact. Circumcision probably reduces the risk of contagion. For women, antiseptic douches have some value, depending largely upon the thoroughness and timeliness of the application for its effect.

The prophylaxis of syphilis by the early injection of arsphenamine entails more hazard than benefit. Experimental work on animals has shown that the spirochetes reach the lymph glands within a few hours after infection, and the disease is generalized long before the appearance of the secondary eruption. In the face of these facts, the early injection of salvarsan may do no more than suppress indefinitely the appearance of a positive Wassermann test. However, the most important objection to arsphenamine prophylaxis at present is the suspicion of syphilis cast forever upon the individual. Usually those patients who apply for prophylaxis even with a history of frank exposure, if they are watched carefully, both clinically and serologically, will not show any evidence of the disease and can be told after a period of three or four months that they have not contracted and have never had syphilis. Such information, which is extremely gratifying, is denied those unfortunates who have received prophylactic arsphenamine treatments. Except within an hour or two after exposure, arsphenamine prophylaxis at present is upon too uncertain a basis for practical use.

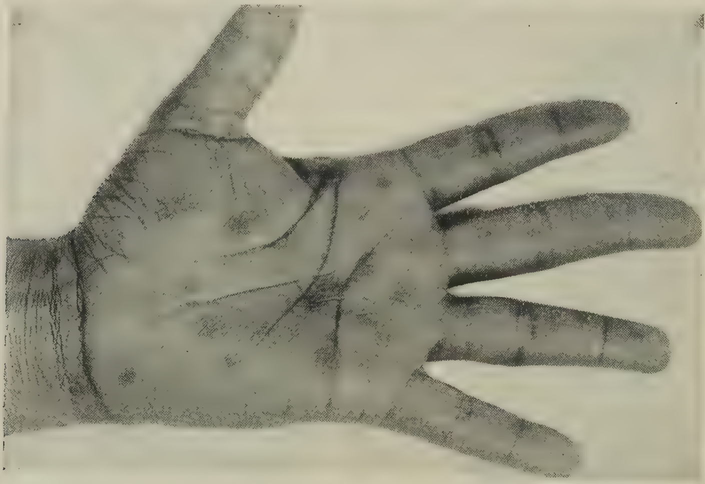

Fig. 612.—Macular secondary syphilide of the palm.

Latency.—Natural immunity to syphilitic infection does not exist among human beings. After infection has occurred, marked variations in individual resistance are observed. In women there is apparently a tendency for the disease to remain latent for long periods, showing only in the birth of syphilitic children. Late neurosyphilis is found less often in women than in men. Pregnancy influences the course of the disease. The latent phase of syphilis and the suppression of the disease during pregnancy may be related to the influence of immune substances. As yet investigations have disclosed very little production of antibodies in the patient's serum. It was due to this latency of the disease during pregnancy that the laws of Colles and Profeta[1] were founded. Kolmer believes that this latency is sometimes transmissible to the child in the uterus, because in congenital syphilis lesions and symptoms may not be clinically apparent for many years after birth.

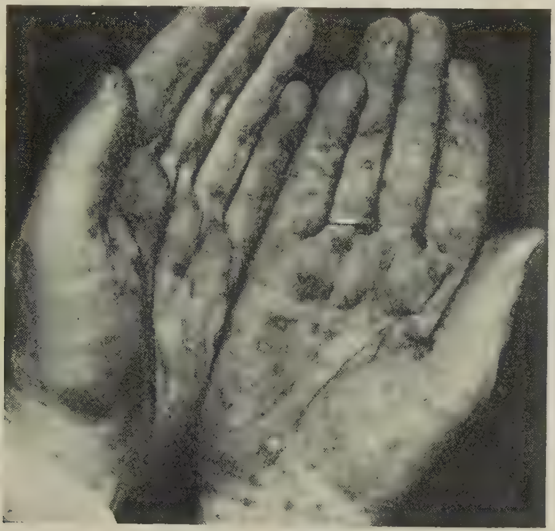

Fig. 613.—Papular secondary syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

TREATMENT OF SYPHILIS

As soon as the diagnosis of syphilis is established treatment should be immediately instituted. The object of treatment is to obtain the greatest benefit for the patient in his fight against the disease, and it varies in different stages of the disease and is influenced by the patient's age and general health. The best results are achieved early in the disease, for the spirochetes in a short time can become so acclimated to the host

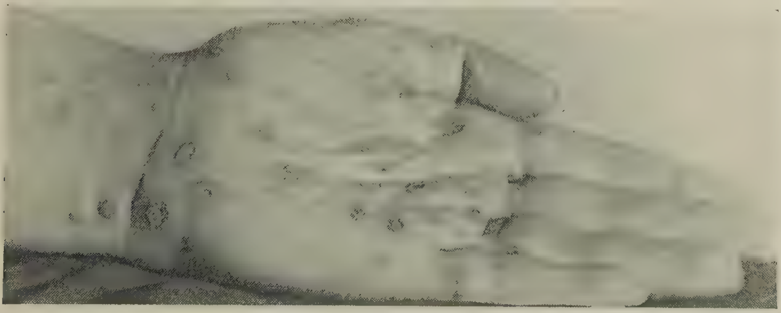

Fig. 614.—Papulosquamous palmar syphilide. (Courtesy of Dr. Binford Throne.)

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[1] Colles' law stated that the mother of a syphilitic child who shows no sign of syphilis herself does not contract the disease from her offspring, although the offspring is infectious to others, as an example, a wet nurse. The mother in such a case has latent syphilis, as can be proved by the Wassermann test. Profeta's law stated that an infant apparently free from syphilis though born of a syphilitic mother could be nursed by its mother without becoming infected by the disease. The Wassermann reaction has shown such instances to be due to latency of the disease in the infant.

that their destruction is more difficult. The benefit from treatment depends not only upon the antiparasitic effects of the drugs but also upon the stimulation of the protective and reparative forces of the body. After syphilitic infection various defensive forces are probably developed locally in the tissues. Some of these are presumably assimilated through the body but their general protective value is slight. Resistance to superinfection is confined mostly to the local site of the disease, as already stated. This local immunity produced by the tissues in immediate environment with the spirochetes probably occurs at all foci where they lodge and has an important influence on the course of the disease, although seldom of great magnitude.

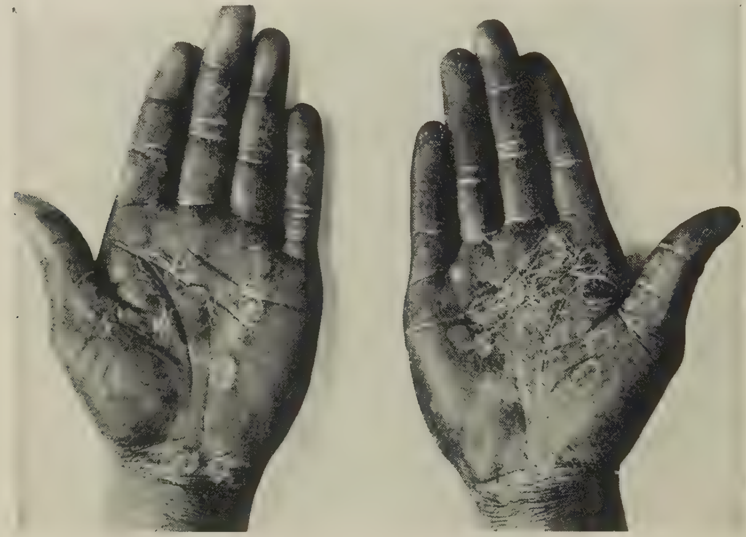

Fig. 615.—Squamous syphilide of palms in secondary syphilis.

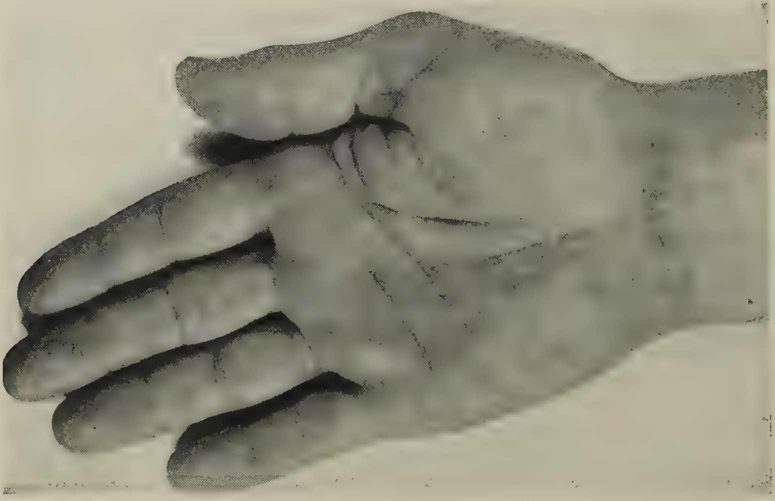

Fig. 616.—Macular and desquamating eruption of the palms in secondary syphilis.

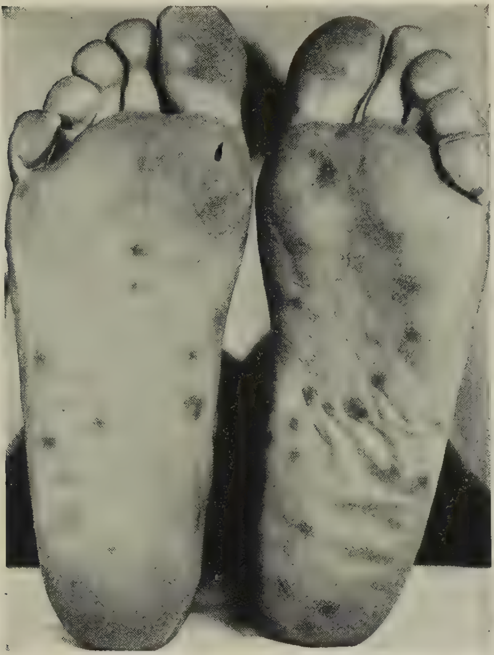

Fig. 617.—Nodular secondary syphilide of the soles.

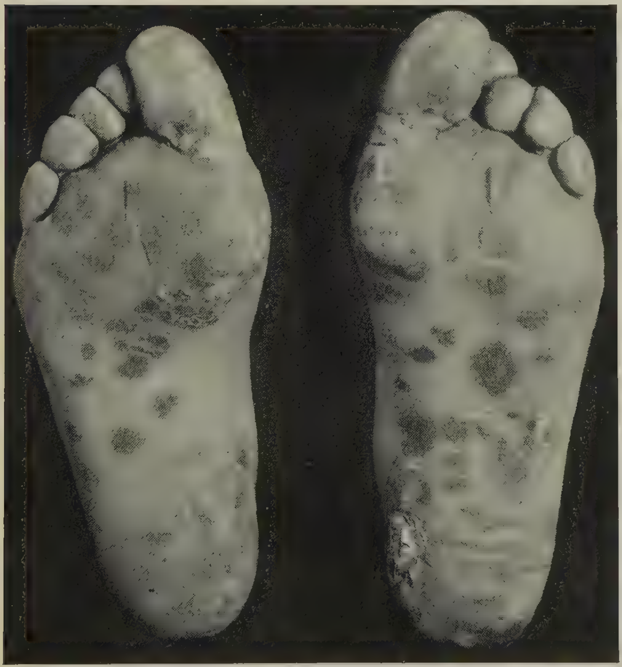

Fig. 618.—Nodular plantar syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

Latency in syphilis may be due to a combination of the effects of immune substances formed in the local tissues together with a reduction of the virulence of the spirochetes and their being walled off by lymphocytes, plasma cells, and fibrous tissue. Little is known concerning the production of immune substances in human syphilitics, but it is possible that some of the beneficial effects from various methods of treatment are due to a stimulation of such protective bodies.

Prophylactic treatment by arsphenamine is, as stated, still too unreliable a foundation to be recommended except when patients are observed a few hours after exposure. This form of prophylaxis may offer great advantages in the future. The work of Brown and Pearce has shown how rapidly the organisms disseminate from the point of infection after local implantation, and the clinical experience of syphilologists has demonstrated the dangers of treatment before a definite determination of whether the disease is present or not. Syphilis, recognized early, is far less serious than syphilis which through unsuccessful efforts at prophylaxis has been delayed in its manifestations and proper treatment. The subjection of anyone to the lifelong burden of doubt as to whether he had syphilis is a serious matter. As stated, most patients who are seen early after suspicious contacts, if left untreated and under frequent physical and serological examination, will show no evidences of the disease and receive a clean bill of health after a few months. In other words, those who might be subjects for prophylactic treatment are usually the cautious, apprehensive individuals who are more frightened than hurt. Prophylactic treatment at present has many practical drawbacks which outweigh its possible benefits.

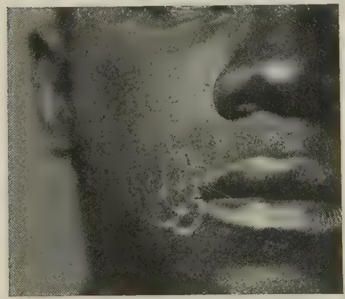
Fig. 619.—Annular secondary syphilide in a negro. (Courtesy of Dr. N. T. Beers.)

Curative treatment is the objective in all except far advanced cases. By far advanced is meant the tertiary stage with frank visceral or neurological involvement. In the early and intermediary stages—primary, secondary, and early tertiary—in otherwise healthy individuals the object of treatment should be curative.

Palliative treatment should be strictly limited to the late stages of the disease, as described above. In persons with old and extensive syphilitic involvements of the cardiovascular or cerebrospinal system, too drastic treatment is often detrimental to the individual. This treatment should be as intensive as possible without injury to the health of the patient, *i. e.*, adequate enough to bring the disease clinically and serologically to a point of arrest, without damaging vital organs. Thereafter the treatment should be milder but continuous, and sufficient to prevent relapses.

The word "*cure*" is unfortunately applied to syphilis as well as to cancer. For the sake of manifesting a comprehension of the ambiguity of the word, as well as the special hazards of these two diseases, the term "arrest" should be used instead of "cure." There is no standard for determining either by clinical examination or by laboratory tests that a patient is ever cured of syphilis. Many criteria point to the probability that cures in the early stages of the disease are quite common. Time and persistent adequate treatment in most early cases cause the disappearance of clinical manifestations and serological signs.

The accidents which are occasionally observed after apparent freedom from the disease upset our convictions regarding "cures." Such manifestations are more common in women, being illustrated by the birth of syphilitic children years after clinical and serological "cures." The absence of any definite criteria of cure brings about the necessity of observation of the syphilitic throughout life. After the activity of the disease has been arrested or its clinical and serological signs have disappeared, annual visits, with a blood test, are usually sufficient.

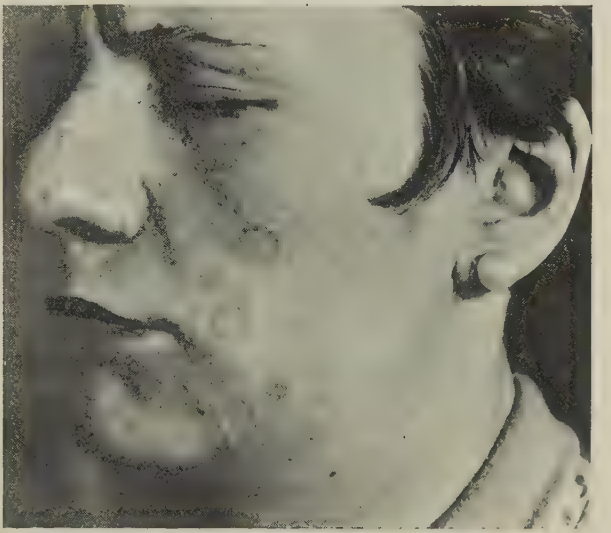

Fig. 620.—Secondary syphilis, annular lesions.

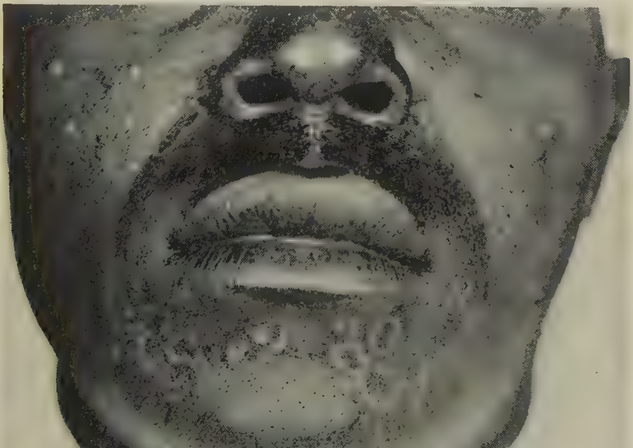

Fig. 621.—Annular syphilide in a negro.

The value of prolonged treatment is urged by all who have studied the disease and its effect upon mankind. "Syphilis is a disease which is worn out, rather than crushed."[1] Moore and Kemp found, in a study of more than 400 cases, half of which had been observed for three or more years, that with seronegative primary syphilis, in which the patients received one to eight injections, relapse occurred in 76 per cent of cases; following six to twelve injections, relapse in 54 per cent; following thirteen to twenty injections, relapse in 14 per cent; and following twenty-one to forty injections, no

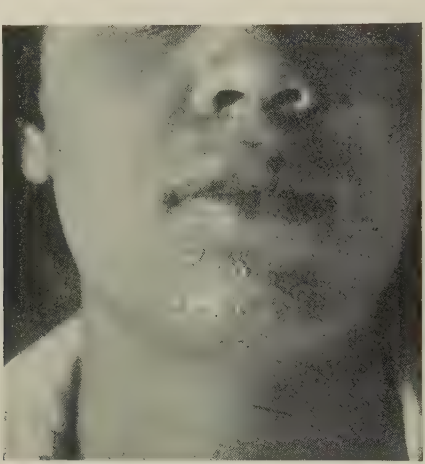

Fig. 622.—Ringed eruption in secondary syphilis in a negro. (Courtesy of Dr. Kendal Frost.)

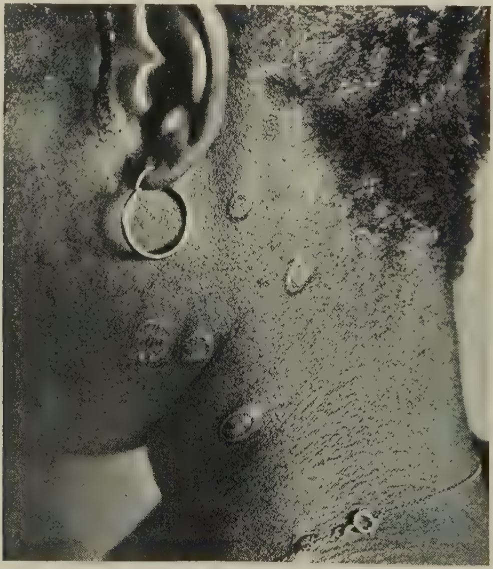

Fig. 623.—Discoid syphilide.

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[1] Stokes, J. H.: Problems and Methods in the Treatment of Syphilis, New York State J. Med., 26: 566, June 15, 1926.

relapse whatever. In seropositive primary syphilis, and florid secondaries, the figures are confirmatory both of the value of prolonged treatment and of the greater incidence of relapse once the patient becomes Wassermann positive. Following one to eight injections in florid secondary syphilis likewise, for example, relapse occurred in 90 per cent; after six to twelve injections, in 67 per cent; after thirteen to twenty injections, in 48 per cent; and

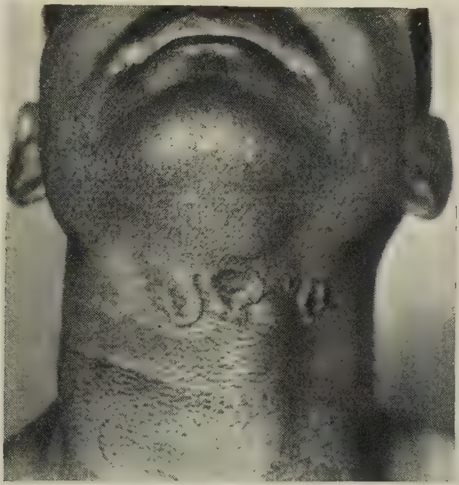

Fig. 624.—Large ringed syphilide of neck, secondary period. (Courtesy of Dr. A. B. Cannon.)

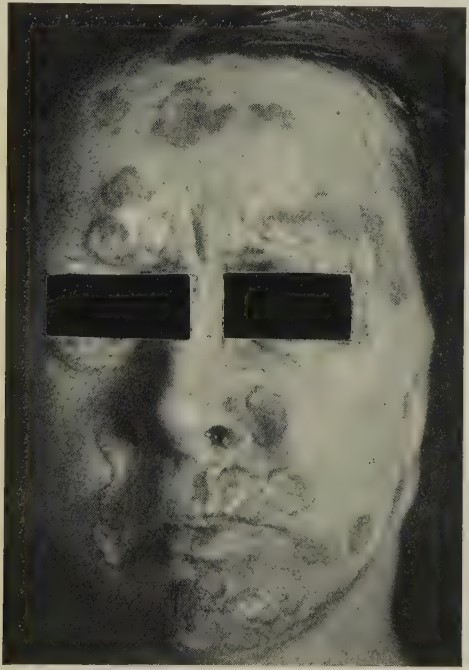

Fig. 625.—Discrete and confluent annular secondary syphilide of the face, in a white patient. (Courtesy of Dr. M. B. Parounagian.)

after twenty-one to forty injections, in 23 per cent. Becker and Stokes,[1] in a smaller group (116 cases), were able to indicate the same facts graphically, and Mutschler has published an interesting comparison of the better results obtained with two courses of twelve injections as compared with one course.

Importance of Skilful Technic.—Although the technic for the treatment of syphilis is taught in the undergraduate course and in hospital studies, the experience derived from such work is usually insufficient to give more than a smattering of knowledge to the practitioner. Experience is the most practical teacher, but certain points may be learned from a text-book. Perfected technic not only lessens the discomfort of the patient, but at times permits the use of medication which would be impossible in less skilled hands.

It may seem trite to say that good light and sharp needles are of great importance, but failures to puncture the veins or the spinal canal are usually due to neglect of one of these prerequisites. It is also essential to have the patient in a comfortable position and for the operator likewise to be at ease. The patient should be lying on a table or couch. This relaxes the muscles and avoids any difficulty in case of fainting. Strict asepsis should be employed as in other surgical procedures.

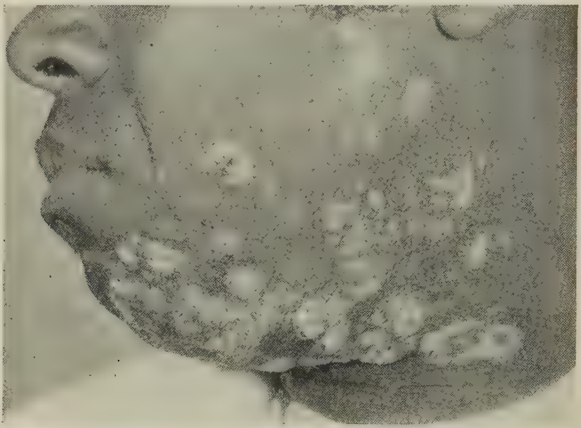

Fig. 626.—Papulosquamous secondary syphilide of bearded area tending toward the annular form.

Needles.—Needles always require sharpening before they are used, even when newly purchased. It is preferable that they should be sharpened by the person who is to give the injection as, if others are depended upon for this work, unless they are well trained the results will be unsatisfactory. Although points can be made too sharp by being tapered to an extreme degree, in general the tendency is for them to be too blunt and without enough bevel. The correct amount of beveling is illustrated in the accompanying diagrams. Besides this feature, it is important to smooth the edges so that there is no feathering of the metal either on the external edge of the point or on the inner edge. Feathering of the inner edge is eliminated by inserting a small stylet to turn the frayed edges outward and then rubbing them off upon a sharpening stone. Stylets should always be kept within the needles as they insure a patent lumen.

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[1] Stokes: Modern Clinical Syphilology, p. 549.

For intramuscular injection an all-glass Luer 2-cc. syringe and 18-gauge needles, 2 to 2½ inches in length, are employed. For infants they should be 1 inch in length and of the same gauge. For intravenous injections with the syringe method, an 18-gauge needle is desirable, both for adults and children. Sixteen-gauge needles are often used for drawing the blood for the Wassermann test and for intravenous injections with the gravity apparatus. When the veins are difficult, small injections may be given through a hypodermic needle attached to a syringe. Spinal needles for adults and children are usually 18 gauge.

Intramuscular Injections.—The importance of proper technic for intramuscular injection of antisyphilitic drugs is often appreciated more by the patient than by the physician. When carefully manipulated such injections are usually painless, and are conducive to a better reception of treatment. Injections are best given while the patient is lying prone upon the table, toes rotated inward and heels outward, so as to relax the gluteal muscles. A point is chosen at a level with the upper end of the gluteal crease, at least 2 inches lateral to it at the inner angle of the upper outer quadrant of the buttock. Injections are alternated between the right and left buttocks and never given in places already lumpy from previous injections. Epifascial injections are easy to attempt but difficult to make. On account of the vascularity of the inner half of the buttock, giving intramuscular injections in this area increases the possible hazard of pulmonary embolism. In fat people the exact site of injection is not so important as in those who are thin, but points near the sacrum are likely to be painful due to proximity to the periosteum and the roots of the sacral plexus, whereas those on the lower parts of the buttock are liable to pressure on sitting. In the inner angle of the upper outer quadrant the injections may be deep enough to deposit the material within the muscle without the danger of striking bone.

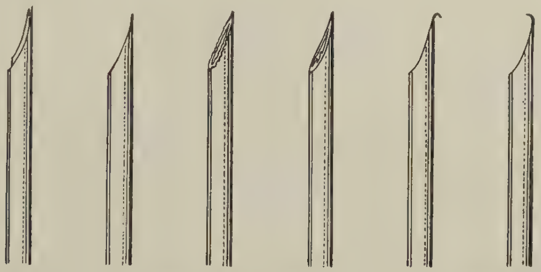

Fig. 627.—Illustration of various needle points: (1) Spinal needle with poorly fitting stylet, causing double point; (2) properly shaped point; (3) feathered edges; (4) after a needle is sharpened, small particles of metal may project into the lumen and be pushed outward when the stylet is inserted; (5) and (6) points bent over, usually due to carelessly dropping needles into sterilizer. (After Stokes.)

The instruments are preferably sterilized by boiling and used while still warm so that the injected material is about the temperature of the body. Attempted sterilization by alcohol is objectionable, because the injection of even a small residue of alcohol remaining in the needle or syringe will cause pain. All needles should be equipped with stylets so that there is no doubt as to whether the lumen is patent.

The site of injection is sterilized with tincture of iodine. The syringe is filled with the material for injection, the needle not being attached to it.

The skin of the buttock is then drawn to one side by the physician's left hand, and the needle, free of the stylet, is plunged deliberately and rapidly almost up to its hub into the buttock. (When the injection is properly done, the contents should lie in the muscle. Injections which are given too deep may cause inflammatory nodules which are very painful, and there is always the danger of striking a bone and breaking off the end of the needle, or plac-

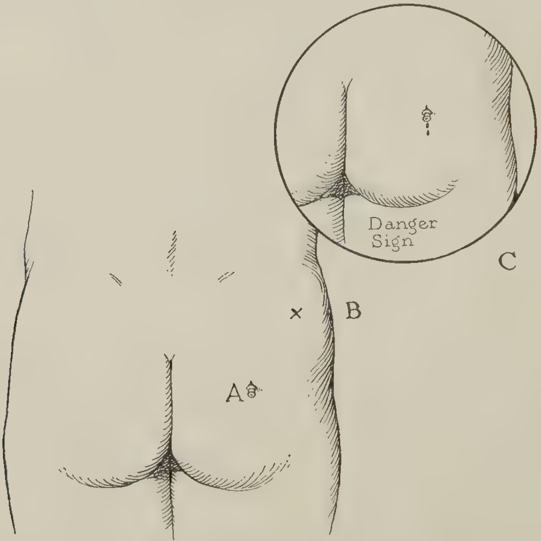

Fig. 628.—A, Correct site for intramuscular injection. B, Site sometimes used advantageously. C, Bleeding, indicating that the needle is possibly in a large vessel and that any material which is injected may cause an embolism.

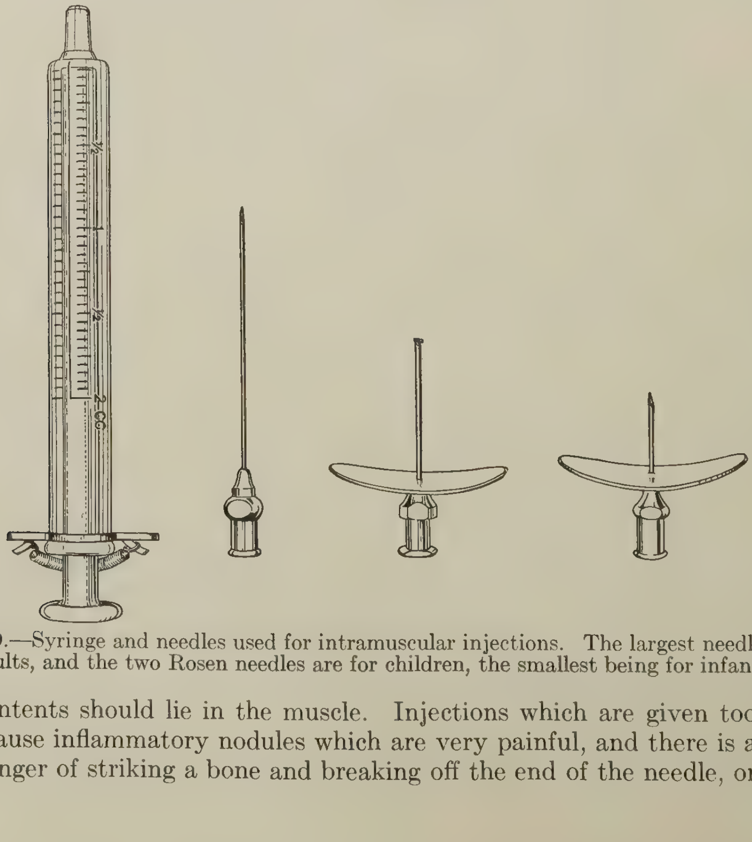

Fig. 629.—Syringe and needles used for intramuscular injections. The largest needle is for adults, and the two Rosen needles are for children, the smallest being for infants.

ing the injection near the sciatic nerve. Such errors are to be avoided. Injections which are too superficial cause indurations in the skin or subcutaneous tissue, which are exceedingly painful and are absorbed slowly.) If there is no bleeding, the syringe containing the medicament is attached to the needle, but before the solution is injected, suction is exerted by withdrawing the plunger slightly. If this aspiration does not draw out any blood, the material is slowly injected, while simultaneously the physician removes his left hand from the buttock. The syringe is then disconnected from the needle, is filled with 1 cc. of air and is again attached to the needle; the air is injected into the buttock. This forces the residue of the material in the needle into the tissues so that when the needle is withdrawn there is none of the injected material left along the needle track. Deposition of material along the track increases the chances of pain and infection. The needle with the syringe attached is withdrawn rapidly, speed tending also to decrease the likelihood of remnants being left in the path of the needle. The skin over the site of injection and the deeper parts are then massaged, deep pressure with the fingers on a piece of gauze with a circular motion being used. After this massage and after any bleeding from the skin capillaries has stopped, the point of injection is not covered with gauze or adhesive tape.

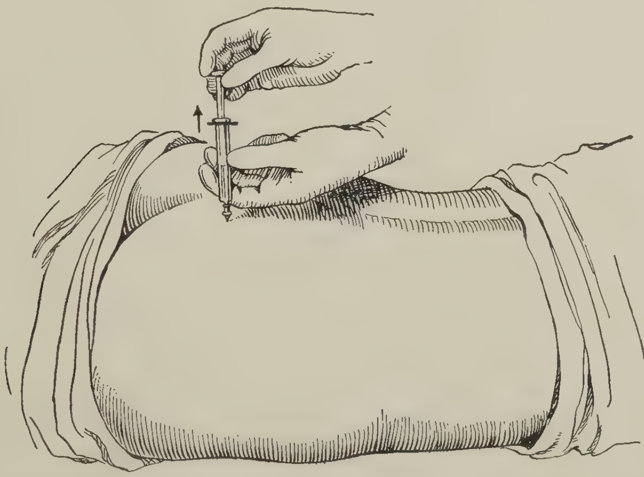

Fig. 630.—Aspiration to test for the presence of blood before giving an intramuscular injection. (After Stokes.)

After the introduction of the needle if there is bleeding it is evidence that the needle is within a vein or at least in the proximity of a large blood vessel. Even the smallest amount of blood should be considered a warning and cause the needle to be withdrawn and another site to be chosen for the injection. Failure to observe this precaution may have fatal consequences due to embolus of the material injected. It is presumed that the operator is observing the rule that a stylet should be within every needle until immediately prior to its use.

Pain during injection, if the needle point is good, results usually from the needle or the injected substance being too hot, or from the presence of some alcohol, either on the needle or within the syringe.

The important points in the technic are the proper instruments, the prone position, the site selected for the injection and the avoidance of depositing the material into a blood vessel. As stated, carelessness concerning the last precaution may lead to fatal embolism. If a needle with a patent lumen is introduced alone and then aspirated after attachment of the syringe, the double precaution thus exercised is a guarantee against such an accident.

Aside from the possibility of embolism, the complications of intramuscular injections[1] are indurations, pain in the leg, and rarely abscesses or broken needles. The indurations are most common; they may be superficial or deep. Those which are superficial are as a rule due to improper technic, *i. e.*, introducing the solution too near the surface. Although painful the indurations are generally absorbed in the course of a few weeks without forming abscesses. Without any error in technic, it seems that some patients react to each injection by the formation of a deep nodule. This is an idiosyncrasy which is often overcome by the use of a different drug or a different preparation of the same drug. It is useless to continue injections of a drug which rapidly becomes encapsulated, for it is not absorbed.

Lumps at the site of injection are usually slow to disappear. When they are superficial they should be massaged by the patient for fifteen minutes three or four times a day and the skin over them may be painted with tincture of iodine two or three times a week. The hot sitz bath effectively relieves the pain, but is of greater use for the deeper indurations. Hot compresses and massage are also beneficial in case of deep nodules. Occasionally there is a stiffening of the whole leg accompanied by pain, which travels down it. This condition results from placing the injected material deep and near the sciatic nerve or the sacral plexus.

Abscess formation is seldom the result of injection. It is a rare occurrence, but when observed is generally due to the fact that injections have been given more rapidly than the medicament has been absorbed and the accumulation of the material has led to a chemical abscess, the contents of which are sterile. Abscesses are more frequent in infants than in adults, being chiefly found in those infants who are treated intramuscularly with neoarsphenamine. If abscess formation is suspected, it should be treated by poulticing and then, fluctuation being frank, by incision and drainage.

Intravenous Injections.—For intravenous injection the patient should be in a recumbent position. A tourniquet, preferably a flexible rubber tube 30 inches in length, is placed around the middle of the upper arm about 3 inches above the elbow. It is tightened as much as possible without shutting off the radial pulse at the wrist and is held in position by the two ends being clasped in a hemostat. Care should be taken not to twist or pinch the skin of the arm during the tightening of the tourniquet. After the veins have become congested, one at the elbow is selected for the point of injection. The median basilic vein or one of its tributaries is usually the best adapted for the purpose. One should choose the vein carefully, avoiding those which are small and movable or are thrombosed. Preference should be given to large veins which are fixed and are not thickened. In difficult subjects it is advisable to choose the vein carefully and have the tourniquet around the upper arm before the patient lies upon the table. For increasing the prominence of the vessel the forearm should be extended and lowered as much as possible. The area chosen is sterilized by iodine followed by alcohol and then dried with sterile gauze. The vein may be brought into greater prominence by having the patient make a fist and hold the tightly clenched fist and by the operator slapping the skin of the elbow or snapping his fingers on the skin overlying the vein.

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[1] Gammel, J. A.: Local Accidents Following Intramuscular Administration of Salts of the Heavy Metals, Arch. Dermat. and Syph., 18: 209–223, Aug., 1928.

The experienced operator can generally do intravenous work expeditiously without the use of local anesthesia. In those who have unusually difficult veins the injection of a few drops of 2 per cent novocaine solution into the skin at the site of puncture will decrease the discomfort. For routine work, however, local anesthesia is not desirable. If the needle is sharp and the veins are even moderately large and prominent, there is less pain from the intravenous injection than there would be from the injection of novocaine.

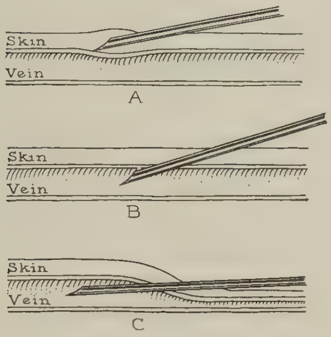

Fig. 631.—Diagrams showing the successive positions of the needle in making an intravenous injection: A, Entering the skin above the vein; B, angle for entering the vein; C, advancing the needle within the lumen before giving the injection. (After Stokes.)

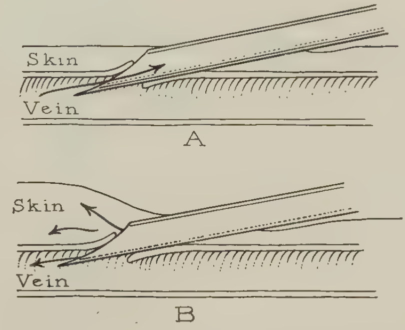

Fig. 632.—Illustrating the effect of partial puncture of a vein with a long beveled needle: A, Return flow of blood has been secured without the needle being completely within the vein; B, infiltration of the subcutaneous tissue as soon as injection is begun. (After Stokes.)

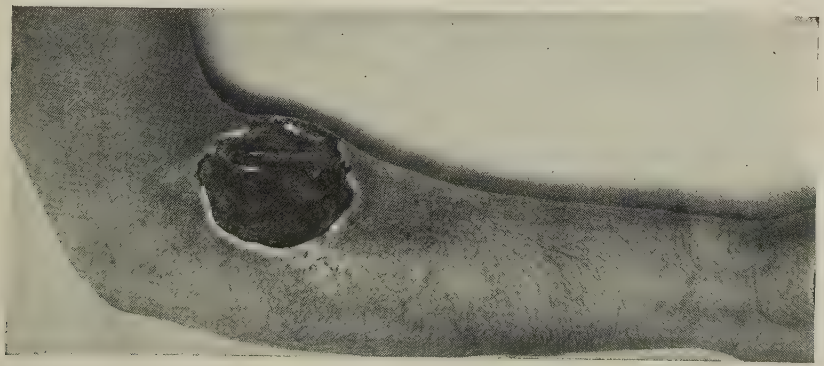

Fig. 633.—Ulceration and sloughing due to faulty technic in arsphenamine administration. (Courtesy of Dr. Mihran B. Parounagian.)

Before an attempt is made to insert the needle, the vein should be carefully palpated both as to depth and as to its exact direction and relation to other structures. A cordlike feeling of the vein due to thrombosis is at times noted when the palpating finger is rubbed over it crosswise. If any thrombosis is suspected, the tourniquet should be released and if the thickening of the wall is still palpable, another vein should be chosen. When the skin over the vein is tough, as it is on the outer side of the elbow or on the back of the hand, the needle should be particularly sharp and the operator should avoid sudden entry, which may cause the needle to go through both walls of the vein.

If the first puncture is unsuccessful, the operator should not endeavor to force the needle into the vein by sticking it wildly about in the tissues. Such a procedure is never successful. If the needle does not go into the vein smoothly and deliberately as expected, it is generally advisable to withdraw it and try another vein. Usually the inclination is to insert the needle into the same puncture again and to try to get the same vein, but this, as a rule, leads to failure. Whenever another vein is at all propitious, it is best to go to it. In case of failure it is advisable to make no comments about the matter to the patient, as generally it is not the failure so much as the fear of the effect of the failure on the patient's mental attitude which upsets the operator. When a hematoma has formed, another vein should always be used.

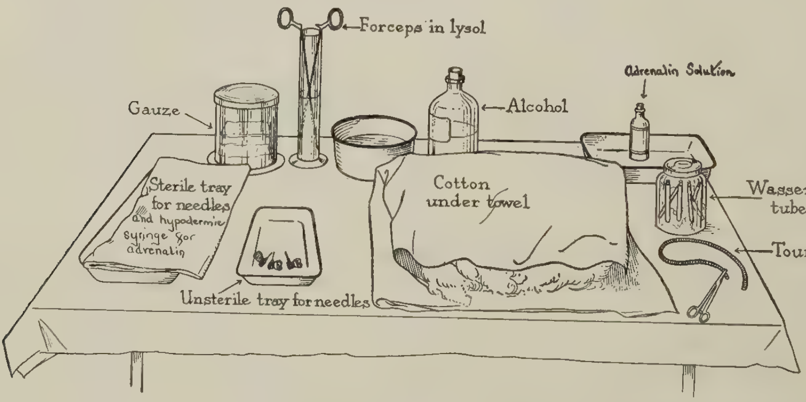

Fig. 634.—Table for arsphenamine injection.

With the patient's forearm fully extended, the needle is slowly introduced through the skin and into the vein in a deliberate, careful manner, this process being divided into four phases, which, however, through practice, gradually become a matter of intuition. The vein having been outlined and the skin over it having been put upon a stretch by traction with the operator's left hand, the insertion of the needle is begun. The first step is a puncture of the skin, the second is the advancing of the point in the direction of the vein in the subcutaneous tissue overlying it, and the third step is the puncturing of the wall of the vein, after which the needle is pushed into the vein for a distance of at least 1 cm. These four stages will be discussed in detail.

1. The needle is inserted through the skin overlying the vein at a carefully chosen point about 1 cm. distant from the point in the vein where the puncture is intended. The left hand of the operator holding the skin taut should not permit a movement of either the arm or the vein.

2. After the needle point has gone through the skin the external end of the needle, which is held by the operator, is lowered so that the inserted part may be pushed into the subcutaneous tissue overlying the vein in alignment with it for a distance of about 1 cm.

3. The needle point being in exact alignment with the vein and directly

over it is now forced slowly but deliberately through the wall of the vein, the external end of the needle held by the operator being lifted.

4. After the needle point has entered the lumen of the vein, the external end of the needle is again lowered so that the angle is less, which permits the needle to be inserted into the vessel for a distance of about 1 cm. without tearing its walls. This is done to avoid extravasation of the injection, and so that the needle will not fall out of the vessel in case the arm moves slightly or there is a back pressure due to the entering stream.

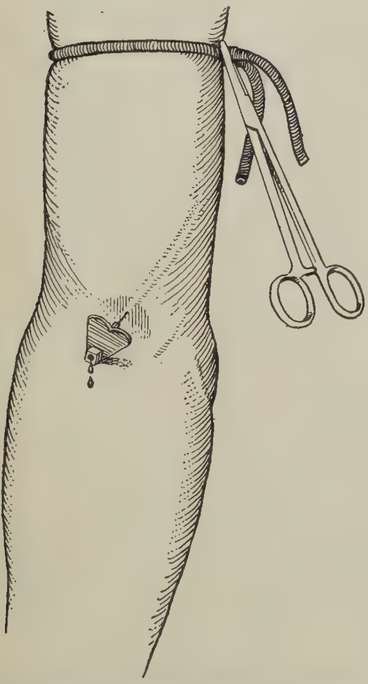

Fig. 635.—Fordyce needle in place.

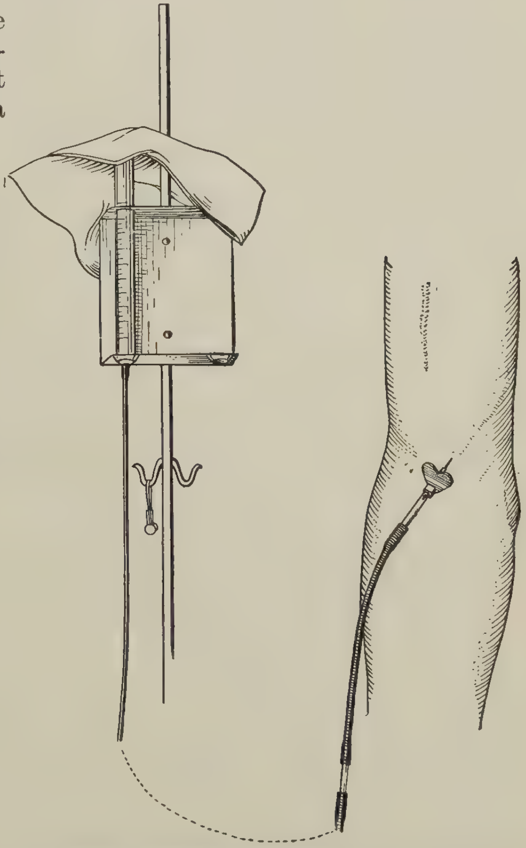

Fig. 636.—Arsphenamine injection being given by gravity method.

The needle being inserted, the gravity container or syringe is connected with it and the salvarsan is introduced, after which the flow is stopped and the needle withdrawn. There is the general impression that one is safe in making intravenous injections so long as the patient complains of no pain, but as a matter of fact, large extravenous infiltrations may be done without causing any pain for an hour or so after the treatment. Pain should not be caused by the injection but its absence is not a criterion that the treatment is progressing satisfactorily. The operator should ever be on guard for slight puffiness or swelling of the skin over the vein beyond the point of the needle, which sometimes will be the first indication of extravasation into the tissues. When the patient complains of pain at the site of injection it is almost invariably due to extravasation, and the injection should be immediately discontinued. The worst necroses are encountered in patients who complained of pain and whose complaints were unheeded.

Pain up the arm or in the axilla is more likely to be due to over-alkalinization than to any other cause. This irritates and causes a spasm of the muscular coat and later a thrombophlebitis. The symptoms are usually mild and disappear upon resting the arm, although after such an experience the vein is generally occluded and may be felt as a hard cord for a distance of several inches above the site of the injection. At times the symptoms are more pronounced, with considerable swelling and redness of the arm. Some mercurials and occasionally iodides used intravenously produce similar conditions. Thrombophlebitis is rarely serious unless it affects the only vein available. When extravenous infiltration has occurred, the best treatment is gentle massage followed by the application of cold, wet dressings or an ice-bag. The dressings may consist of saline solution, boric acid solution, or weak solutions of magnesium sulphate or aluminum acetate. When the infiltration is extensive, an immediate injection of solution of sodium thiosulphate, 1 Gm. intravenously through another vein, is advisable and the dose may be repeated daily two or three times. Large extravasations may lead to chemical ulcerations and sloughs which require months for healing. A few hours after the infiltration the skin over the area becomes swollen and hot and there is great pain in the part. Gradually a brawny edema develops and in the course of weeks this may slough and leave an indolent ulcer.

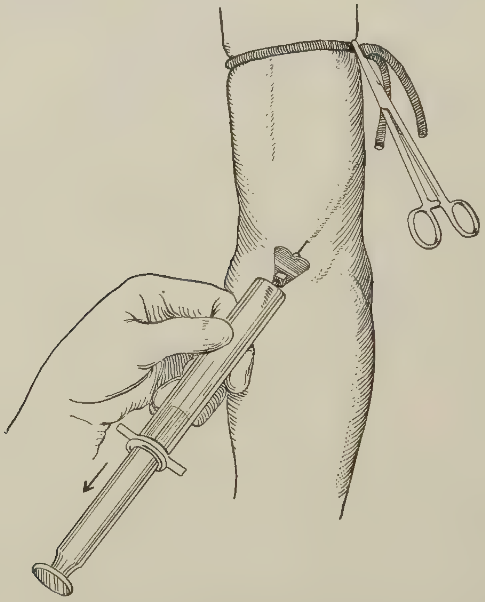

Fig. 637.—Column of blood visible in syringe, indicating that the point of the needle is in the lumen of the vein. (After Stokes.)

Spinal Puncture.—For a spinal puncture the patient should lie on his side on a fairly high bed which has a hard mattress. The knees should be flexed upon the trunk and the shoulders brought forward so that the hands and forearms can be placed beneath the knees to pull them upward. To obtain maximum flexion is important and in most individuals the operator should not be satisfied until the entire forearms, including some of the elbow, are beneath the bend of the knees. After the trunk has thus been flexed, the patient is lifted by the operator so that some of the buttocks and pelvis hang over the edge of the mattress, the head being kept at a level with the spine by some pillows and bent far forward. The weight of the buttocks partly hanging over the edge of the bed tends to separate the spinal articulations and to offset a slight lateral bending of the spine caused by the upper part of the patient's body sinking into the mattress. The greatest ventriflexion possible is attained. The lower back is scrubbed with soap and water, rinsed with alcohol, and painted with tincture of iodine. The joints of the spine are now outlined by palpation of the dorsal spinous processes. In thin patients, care must be taken not to mistake a lateral spinous process for a dorsal one. The spaces between the bony prominences are carefully felt and the one at the level of a line drawn between the crests of the ilia is chosen for puncture. This is usually the interspace between the fourth and fifth lumbar vertebrae. This space is carefully felt with the end of the index finger and thumb to determine its exact location and then a mark is made upon the skin by pressure with the thumb nail in a crisscross manner to indicate the exact site where the needle should enter. The determination of this point is undoubtedly the most difficult part of the whole technic, and it is unusually so in those who are obese or have curvature of the spine or caries.

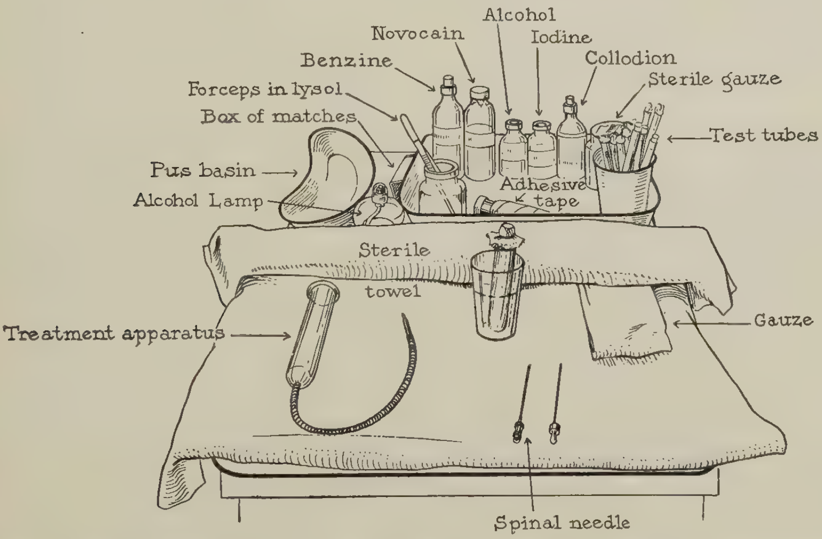

Fig. 638.—Spinal treatment tray. Glass contains hot water and cylinder of salvarsanized serum.

Once the point of puncture is determined, it should be painted with tincture of iodine. After waiting one minute the operator should introduce the needle without delay so that the position of the patient will not change even to a slight degree. The patient should be told not to move regardless of any pain, but simply to hold his breath and that it will all be over in a moment. The needle is then inserted in the midline in the sagittal plane at the point indicated by the cross on the skin and it is guided upward and forward until it impinges upon the spinous ligaments, through which it is then slowly and deliberately pushed. After the point has traversed the ligaments the operator generally feels a definite release to the needle and this lack of resistance indicates that the needle is within the spinal canal. It should be pushed no further for there is the likelihood of damaging the opposite pia and causing hemorrhage, which will give a bloody spinal fluid and interfere with the testing of it. The stylet of the needle is now withdrawn slowly, and the spinal fluid should come drop by drop from the needle. The stilet during withdrawal should be carefully watched so that if the spinal fluid is under great pressure and spurts from the needle, the stylet may be reinserted to control the flow and avoid sudden decompression. In case no spinal fluid appears after the stylet is withdrawn, it may be due to the fact that, although the point of the needle is within the canal, it has not punctured the membranes. In this event, if the needle is rotated a little and inserted a fraction of a centimeter further, spinal fluid may appear, but before such manipulations the stylet should be inserted completely into the needle, for the opening may have be-

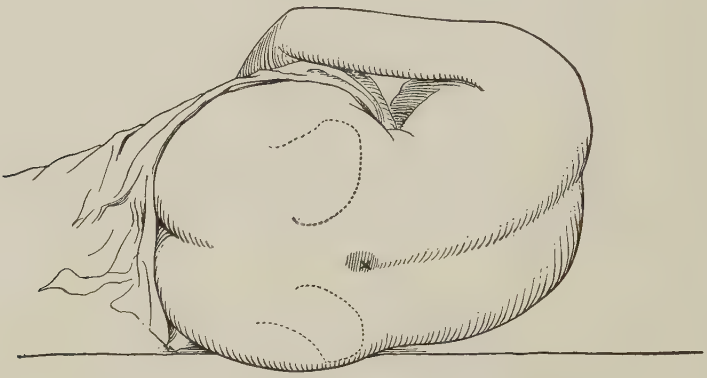

Fig. 639.—Position of the patient for spinal puncture.

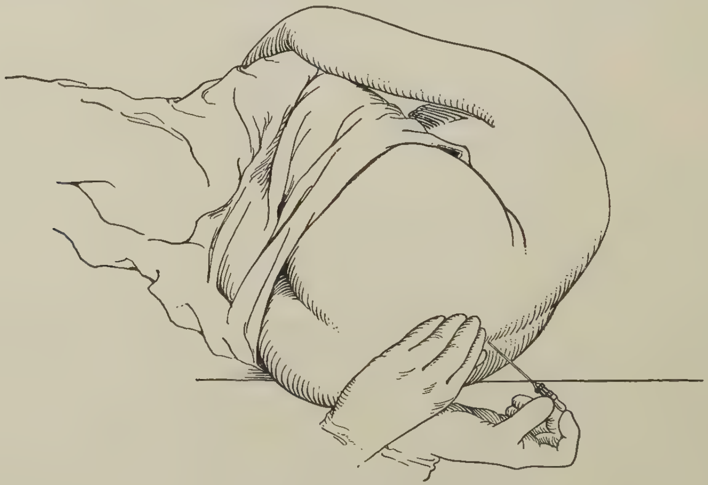

Fig. 640.—Technic for introducing the needle in spinal puncture.

come occluded by a small piece of tissue. In case bloody spinal fluid is obtained, the puncture may be repeated in the space above the one used, but at no time should a puncture be made in any higher spaces than the one above the level of the iliac crests (the interspace between the third and fourth lumbar vertebrae). However, it is not always necessary to make a second puncture on account of the appearance of blood in the spinal fluid, because sometimes the bleeding is only momentary and the blood disappears from the fluid after a few drops or a few centimeters have been collected. For test purposes, two tubes each containing 3 cc. of spinal fluid are desirable, but it is customary to remove larger amounts when there is any bleeding, in the hope of getting one tube which is clear. Usually three tubes may be removed, each containing 5 cc., without causing subsequent headache or entailing danger. When the pressure is low, the flow may stop before this number of tubes is filled and in such cases the needle should be withdrawn. The stylet is not placed in the needle before it is taken out. There is as much pain during the withdrawal of the needle as there is during its insertion, but the removal should

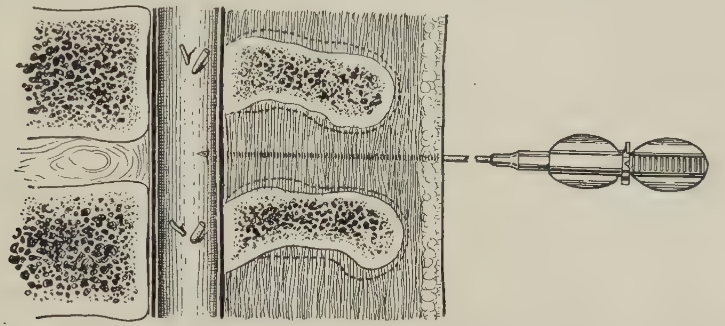

Fig. 641.—Illustration of the anatomical structures encountered in spinal puncture, showing Labat needle which has pierced the dura.

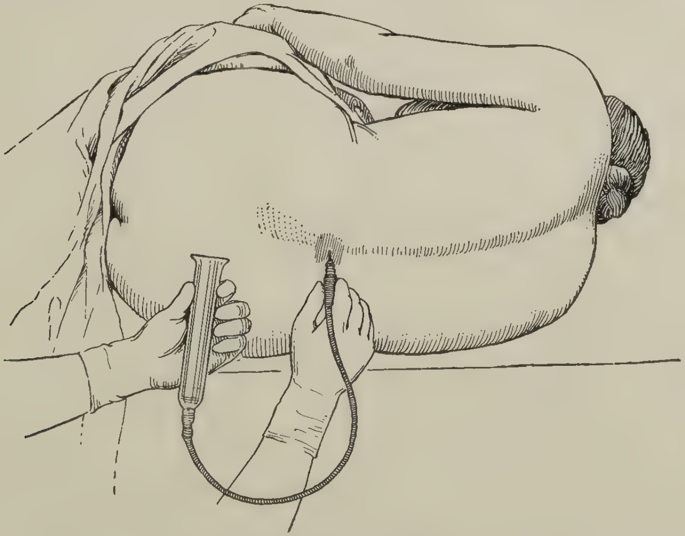

Fig. 642.—Removing spinal fluid prior to adding serum.

be one rapid movement so that the pain is momentary. Before withdrawal, the patient should be told that there may be some pain and not to move. If he is not so warned, he may jump during the process of removal and break the needle off in his back. The patient should at all times be told what the operator is doing. Remember that he has not eyes in the middle of his back and he is rightfully worried and nervous. Therefore, before you touch him with iodine or alcohol or with anything, be sure to tell him what you intend to do so that he will not be frightened and jump.

After the needle is withdrawn, the patient is told to lie still and then to straighten the arms and legs gradually and roll over upon his abdomen without raising the head from the bed. The foot of the bed is then raised 3 inches on blocks of wood and the patient is deprived of pillows. He remains prone in this position for one hour and after that may lie upon his back, but for twenty-four hours should not raise his head from the bed.

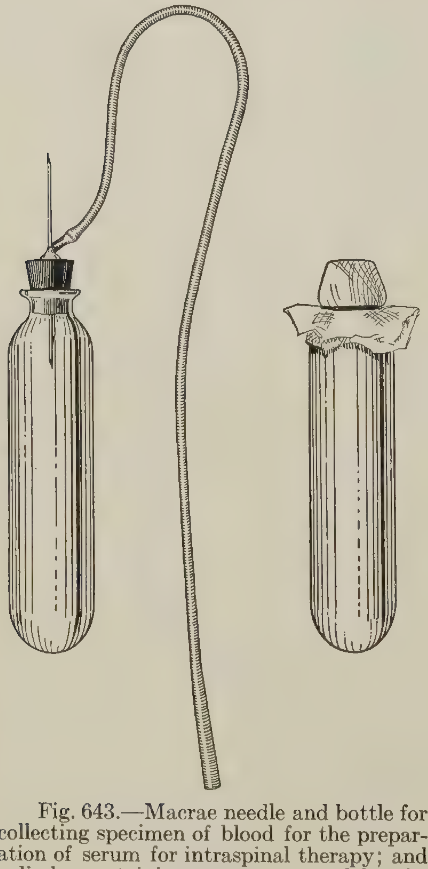

Fig. 643.—Macrae needle and bottle for collecting specimen of blood for the preparation of serum for intraspinal therapy; and cylinder containing serum prepared for the injection.

In experienced hands the principal danger from spinal puncture is severe headache. With careful operative technic other dangers, such as meningitis and sudden collapse, are practically eliminated. Before attempting spinal puncture, the beginner should practice on a cadaver and his first puncture should be made under the guidance of an experienced operator. Headaches usually do not come on for twenty-four to thirty-six hours after the operation. They are generally not felt until the patient gets up and about, or has been up for several hours. Then they come on rather rapidly and may cause vomiting unless he lies down. There is no effective treatment of the headaches except for the patient to lie down, and they are self-limited, disappearing in the course of a few days and rarely lasting as long as a week. Throughout the period the patient must be reassured that they are not serious and that the only method of getting over them rapidly is to give in to them completely and not try to force himself to get up. Pituitrin, aspirin, and morphine are remedies that have been suggested for treatment, but are rarely beneficial.

Cistern Puncture.—Puncture of the cisterna magna has certain advantages over lumbar puncture and it is considered by some to be the method of choice for obtaining cerebrospinal fluid for examination. The subsequent headache and other after-effects of lumbar puncture occur to a lesser degree after cistern puncture, and the fluid obtained is less often contaminated by blood. The procedure has been almost always found easy, and no alarming symptoms have been observed, either at the time of puncture or subsequently. Spiegel states that over 10,000 cases of cistern puncture have been reported with only two fatalities. The chief dangers seem to be from brain tumors or anomalies of the vertebral artery.

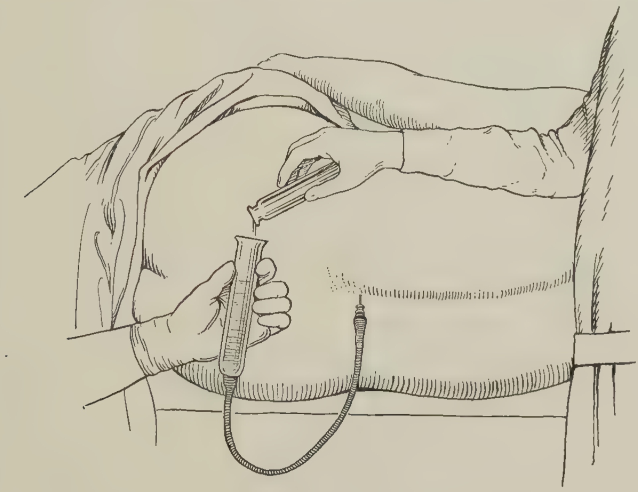

Fig. 644.—Adding serum to the spinal fluid.

The needle is inserted into the occipito-atloid ligament, which connects the posterior edge of the foramen magnum with the corresponding part of the first cervical vertebra. The technic for puncture of the cisterna magna originally described by Ayer is still generally used without any essential changes. "The patient is placed on the side, as if for lumbar puncture, with neck moderately flexed. Care is taken to maintain the alignment of the vertebral column to prevent scoliosis and torsion, and in cases where compara-

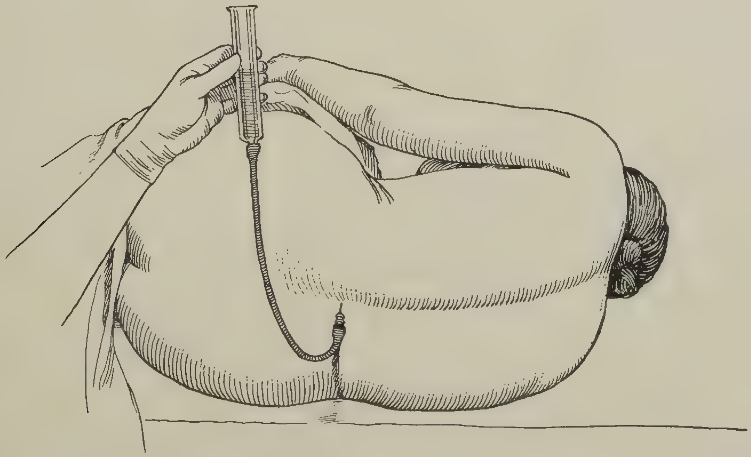

Fig. 645.—The apparatus is elevated so that the mixture runs into the spinal canal by gravity.

tive pressure readings are important the lumbar and cisterna needles should be on the same horizontal plane. After antiseptic preparation of the skin, usually including the shaving of a little hair, and local anesthetization with procaine, the thumb of the left hand is placed on the spine of the axis, and the needle inserted in the midline just above the thumb. The needle may be pushed rapidly through the skin, but should then be cautiously and guardedly forced forward and upward in line with the external auditory meatus and glabella, until the dura is pierced. If the cisterna be entered at this angle there is usually a distance of from 2.5 to 3 cm. between dura and medulla as shown on frozen section; with the needle less oblique in position the distance between the walls of the cisterna becomes progressively less. Therefore, it is good practice to aim a little higher than the auditory meatus and, if the needle strikes the occiput, to depress just enough to pass the dura at its uppermost attachment to the foramen magnum. At its entrance the same sudden "give" is felt as in lumbar puncture.

"The needle employed is a regular lumbar puncture needle, nickeloid, 18-gauge preferred, with beveled stilet, sharp on the sides, but not too sharply pointed. There is rather less variation in the depth of the tissue traversed than in the lumbar region, being in an ordinary sized adult from 4 to 5 cm., the greatest distance in the series being 6 cm. and the smallest 3.5 cm. It was found that a faint circular scratch on the needles, 6 cm. from the tip, was entirely satisfactory in judging the distance, and was preferable to the deeper markings of the Patrick needle which tend to make its insertion a little jerky and consequently less guarded."

Drugs.—Modern treatment of syphilis is carried on by four drugs: Mercury, bismuth, arsphenamine, and the iodides. Mercury and bismuth are variously compounded, and arsphenamine, representing the organic arsenicals, has numerous homologues. The three drugs of major importance, the newer arsenicals, mercury and bismuth, have a specific spirocheticidal action upon the Treponema pallidum. Iodine has a nonspecific value in the healing of gummatous and other ulcerations and in hastening the involution of indurations.

Arsphenamine.—Arsphenamine, also called salvarsan and "606," is dihydrochloride of 3 diamino-4 dihydroxyarsenobenzene. It is a yellow powder, which is soluble in water and has a strongly acid reaction. Since its discovery by Ehrlich in 1910 it has been the outstanding remedy for the treatment of syphilis. Later modifications, neoarsphenamine, sulpharsphenamine, silver arsphenamine, *et cetera*, are also widely used.

The *chemotherapeutic index* of the arsenicals is an expression of the relation of the maximum tolerated dose to the minimum therapeutic dose, or in other words, it indicates the relation of the toxicity of the product to its therapeutic efficacy. The arsphenamine base is synthetically constructed from arsenical radicals which are trivalent, for these have greater spirocheticidal action than pentavalent arsenic. The chemical combination of the arsenic in arsphenamine has special advantages in the treatment of syphilis. In the body, the arsphenamine is oxidized, forming arsenoxide, which is directly spirocheticidal, and is eliminated in the course of three or four days in the urine and bile, chiefly in the latter.

Preparation.—Arsphenamine is supplied in glass ampules in accordance with strict regulations by the United States Public Health Laboratories as to toxicity in animals. Before being used the ampule should be placed in a small dish and covered with alcohol for ten minutes, and then should be removed, dried, and inspected to see that there are no cracks in it and the powder is mobile. The neck of the ampule should then be filed and broken off and its contents should be spread upon the surface of 25 to 50 cc. of sterile freshly distilled water of room temperature in a sterile Erlenmeyer flask and stoppered. To avoid oxidation of the arsphenamine, which renders it toxic, the solution is made without shaking the flask. After the mixture has stood a few minutes, there is a complete solution. It is important then to add alkali to change the acid solution into the less toxic alkaline solution. The United States Public Health Service recommends for each 0.1 Gm. of arsphenamine the addition of 0.85 cc. of 4 per cent (normal), or 0.227 cc. of 15 per cent sodium hydroxide solution, *i. e.*, for 0.6 Gm. of arsphenamine 5.1 cc. of 4 per cent (normal) or 1.4 cc. of 15 per cent sodium hydroxide solution. These figures give the amount of sodium hydroxide necessary to form the disodium salt of arsphenamine, and they include an excess of one third of that amount required to just redissolve the light yellow precipitate which first forms. Satisfactory clinical results are generally obtained by adding one fourth the excess of alkali—0.212 cc. of 15 per cent solution of sodium hydroxide for each 0.1 Gm. of arsphenamine, which is approximately 18 drops for 0.6 Gm. As the alkaline strength of the mixture used changes upon standing, the solution should be frequently titrated to assure accuracy. If no means of accurate measurement are available the following technic may be employed; the alkali solution (about 15 per cent sodium hydroxide solution) is added drop by drop to the acid arsphenamine solution until the light yellow precipitate, which at first forms, completely redissolves, resulting in a clear solution. The drops should be added slowly, being counted, and the flask should be stoppered and gradually inverted several times to insure uniform distribution of the alkali. To the clear solution there should then be added one fourth of the original number of drops of the alkali. The resulting alkalinized solution should be diluted with freshly distilled sterile water of room temperature until the desired concentration is obtained, with 20 to 30 cc. of water for each decigram of drug. The solution is then filtered through sterile filter paper, cotton, or gauze. A cloudy or turbid solution should never be injected, because of the danger of severe reactions from it. Solutions should be used as soon as possible after preparation as they gradually increase in toxicity due to oxidation upon standing exposed to the air. Erlenmeyer flasks or tall relatively narrow cylinders are used to minimize oxidation by reducing the surface of fluid exposed. Injections should be by the gravity method, care being exercised that the rate of flow is not too rapid, as fast administration increases the toxicity. The most important of all precautions is that the acid solution should not be used, because this is far more toxic than the alkaline solution and may be lethal.

Conditions Governing Dosage.—Dosage is regulated by the patient's age, body weight, and general condition. The initial dose should be small, as some subjects are hypersusceptible to the drug. After tolerance has been established, the average dose for adult males is 0.6 Gm. once a week and for females 0.4 Gm.

A physical examination should be given to each patient before arsphenamine treatment is begun. In patients who have myocardial and renal disease, pulmonary tuberculosis, or cerebrospinal syphilis, particular circumspection is necessary, neoarsphenamine often being more desirable. In previously untreated syphilis, especially where there are signs of involvement of vital structures, arsphenamine should not be given until the patient has been prepared by treatment with mercury or bismuth. If there is no fever or severe visceral disease, the initial dose should be 0.2 Gm. in all latent or late cases. In healthy young adults in the primary or secondary stages, where spirocheticidal action without delay is desired, 0.4 Gm. may be given for the first and successive doses unless poorly tolerated. Body weight influences

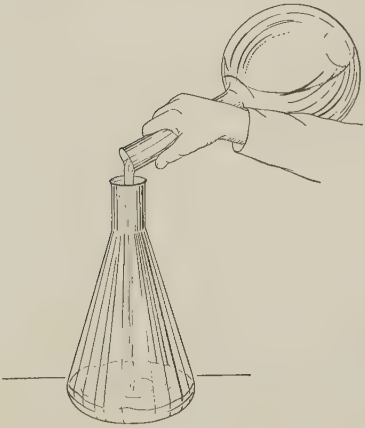
Fig. 646.

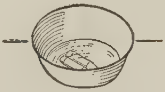
Fig. 647.

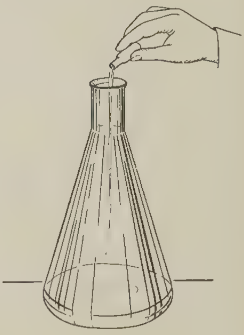
Fig. 648.

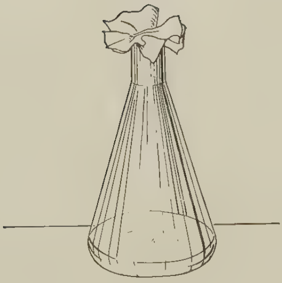
Fig. 649.

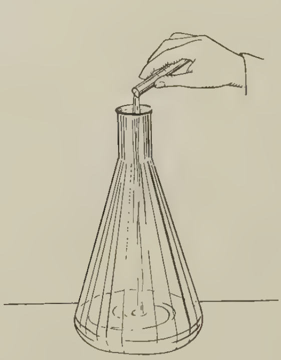
Fig. 650.

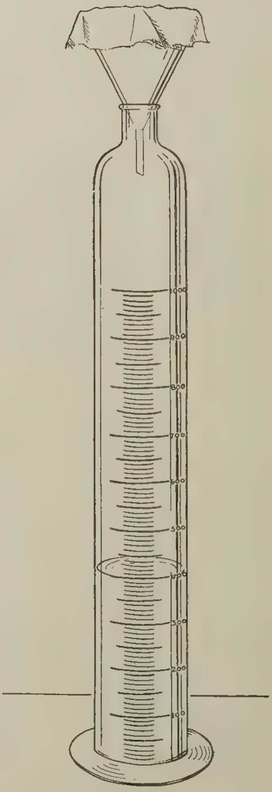
Fig. 651.

Fig. 646.—Sterile distilled water poured into Erlenmeyer flask.

Fig. 647.—Ampules soaked in alcohol at least ten minutes.

Fig. 648.—File off top of ampule and pour contents upon water.

Fig. 649.—Allow to dissolve without disturbing.

Fig. 650.—Alkalinize by adding sodium hydroxide solution.

Fig. 651.—Filter into graduate and allow to stand for at least fifteen minutes before injecting.

dosage, the average doses being reduced for individuals who are under 140 pounds and sometimes even increased to more than 6 decigrams for those over 160 pounds and below forty years of age and in good health. The physical condition and weight of the patient are better guides to dosage than age, although there is a general tendency to reduce the dose in elderly patients.

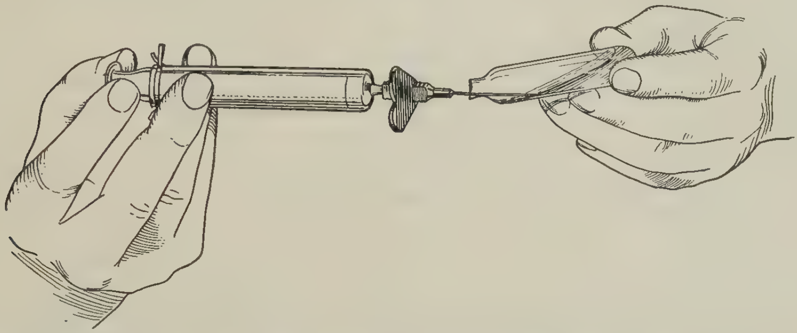

Fig. 652.—Making a concentrated solution of neoarsphenamine. The ampule is used for mixing.

These dosages must be modified whenever there is an idiosyncrasy to arsphenamine. Such hypersensitiveness is indicated by reactions after administration. Dosage must also be restricted in the presence of severe visceral disease, in pregnancy and in those who have eczema or urticaria. The organic involvements which are most important are those of the cerebrospinal system, those of the cardiovascular system, of the lungs and of the kidneys. Optic atrophy is another indication for caution in the administration of this drug. During acute respiratory infections and all febrile conditions except those caused by syphilis, injections should be suspended or dosage considerably reduced. When syphilis is associated with active pulmonary tuberculosis, the treatment of the former should be extremely cautious and moderate.

Arsphenamine is by far the best drug for young otherwise healthy syphilitics in the early or intermediary stages of the disease when hope of a complete cure is maintained. In such cases it should be given persistently once weekly in doses of 0.4 to 0.6 Gm. for adults.

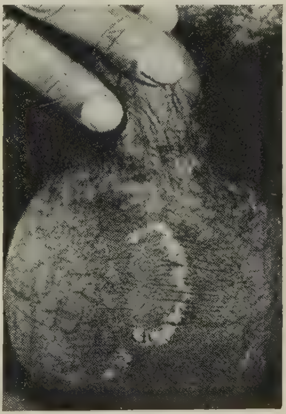

Fig. 653.—Circinate syphiloderm of scrotum. Tertiary stage. (Courtesy of Dr. Mihran B. Parounagian.)

Neoarsphenamine.—Neoarsphenamine (neosalvarsan and "914"), which is a yellow hygroscopic powder freely soluble in water and unstable in air, is produced by treating 3 diamino-4dihydroxyarsenobenzene with formaldehydesulphoxalate. The drug is prepared for injection by dissolving it in distilled water at room temperature. It goes into solution rapidly, vigorous shaking being avoided as this causes oxidation, which increases the toxicity of the drug. Neoarsphenamine is less stable both in the ampule and in solution than arsphenamine. The solution gives a neutral reaction, so that it does not require sodium hydroxide before it is ready for injection. As it has approximately the same hydrogen-ion concentration as the blood, its intravenous injection causes less biochemical disturbance than the strongly alkaline solution of arsphenamine. In ordinary concentrations neoarsphenamine is not hemolytic, whereas arsphenamine is. Patients tolerate the former better than the latter, and its preparation for injection is more rapid and easier. It has a low toxicity and a higher therapeutic dosage than arsphenamine.

Preparation.—Neoarsphenamine is administered either by gravity or by syringe. A glass piston syringe is suited for the purpose. The syringe method permits the use of a needle of smaller caliber than is required for gravity injection, which is an advantage when small veins are to be entered. Five to 10 cc. of cool water are suitable for any dosage when the syringe method is employed. Hot water should be avoided, as the drug is readily affected by heat. It will be found convenient to prepare the solution in the ampule, if no more than 5 cc. of water are to be added. If more than this amount is to be used, a portion of the distilled water may be retained in the syringe and the solution may be alternately drawn into and discharged from it. If the solution is not brilliantly clear, it should not be used.

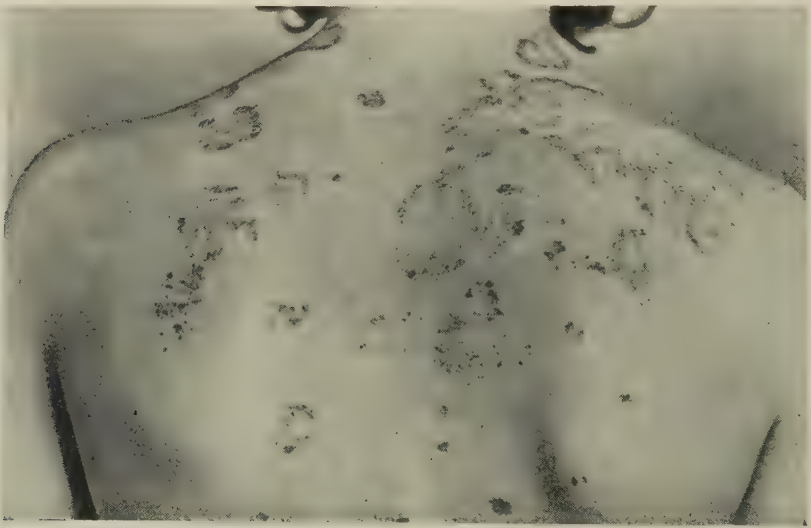

Fig. 654.—Tertiary serpiginous syphilide of the upper back.

The United States Public Health Service recommends that neoarsphenamine be administered by the gravity method, which necessitates more elaborate equipment, consisting of a gravity cylinder with rubber tubing, connections, an Erlenmeyer flask of cold sterile freshly distilled water, a graduate for mixing solutions and 20-gauge needles. The solution, which is mixed in the graduate, is filtered through sterile gauze in a glass funnel as it is poured into the gravity cylinder. All rubber tubing should be soaked over night in 5 per cent solution of sodium hydroxide and then thoroughly rinsed with distilled water before being sterilized for the first time. A dilution of 1 decigram of neoarsphenamine to every 10 cc. of water is advised if the gravity method is employed.

Before being used the ampule of neoarsphenamine should be carefully inspected for small cracks in the glass and immersed in 95 per cent alcohol, so that if there is a crack, it will be detected by the moistening and discoloration of the contents. If the color of the powder is distinctly reddish or if the powder is lumpy, it should not be used. If after it is dissolved the solution is cloudy, it should not be injected, as cloudy solutions may cause embolism. No alkali should be added at any time.

Technic of Administration.—Neoarsphenamine should be used intravenously only. After the tourniquet has been applied, the needle is inserted into the lumen of the vein and a column of blood is seen to rise through the glass tip of the syringe and enter the barrel. This is evidence that the needle has penetrated the vein. If at any time one is in doubt as to whether the needle is still in the vein, traction on the piston will draw in blood; if it does not, the needle should be withdrawn and reinserted. Perivascular extravasation will usually cause pain, tumefaction, and an interruption of the flow. The solution should be injected slowly, at least two minutes being consumed for the syringe method and four minutes for the gravity method. Immediate reactions are less likely to occur if the solution is injected slowly.

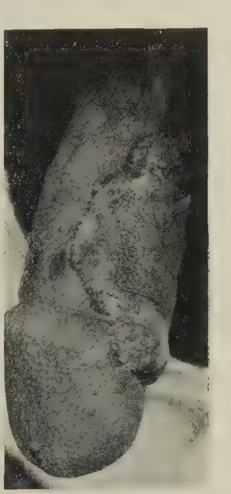

Fig. 655.—Tertiary circinate syphiloderm of penis. (Courtesy of Dr. Mihran B. Parounagian.)

The dosage of neoarsphenamine is influenced by the factors which have been previously mentioned as affecting the administration of arsphenamine. The therapeutic dose is about twice that of arsphenamine; initial doses in untreated cases being 0.2 to 0.3 Gm. and subsequent doses in adults, 0.45 to 0.9 Gm.

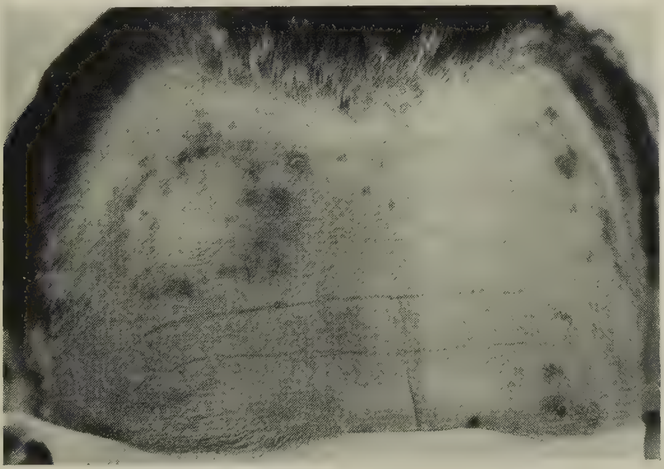

Fig. 656.—Tertiary nodular syphilide of forehead.

Contraindications for the use of neoarsphenamine are not rigid as against arsphenamine, but in the presence of myocardial or renal disease or lesions of the general nervous system, the initial doses should be smaller than usual.

Although neoarsphenamine generally is used in all stages of syphilis, it is particularly valuable in the treatment of elderly and physically unfit subjects.

Sulpharsphenamine.—Sulpharsphenamine is chemically similar to neoarsphenamine but may be used for intramuscular injections and for this reason is especially advantageous in the treatment of children, obese adults and others with inaccessible veins. Stokes believes that its therapeutic effects at least equal those of neoarsphenamine and that it has the highest penetrating power for the nervous system of any spirillicidal drug thus far devised. The principal objections to it are the higher incidence of dermatitis and the fact that its therapeutic status has not been fully established. According to Raiziss, Severac and Moetsch, as a trypanocide, sulpharsphenamine is about one third as efficient as neoarsphenamine. Belding found that dermatitis occurred in 16 per cent of the patients treated and peripheral neuritis in 56 per cent.

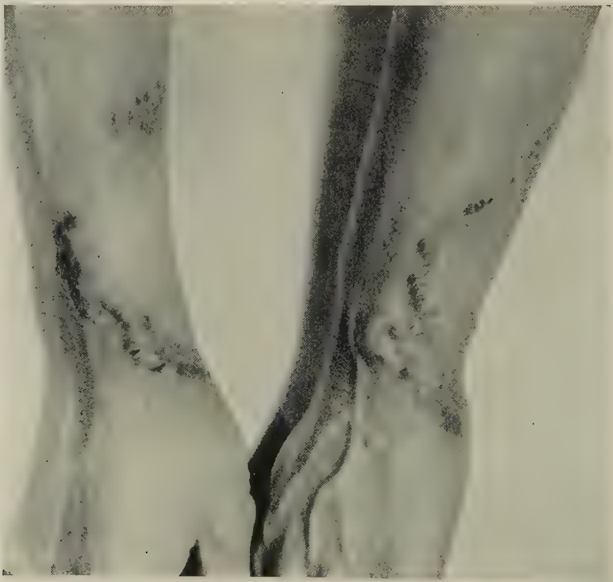

Fig. 657.—Serpiginous tertiary syphilide. Unusual symmetrical distribution.

The dosage of sulpharsphenamine is approximately the same as arsphenamine—0.4 to 0.6 Gm. weekly, unless modified by conditions previously discussed. The drug may be injected intravenously or intramuscularly and is more rapidly eliminated than the other arsphenamines. Stokes and Behn, from a study of 1360 injections of sulpharsphenamine in a series of 126 cases, concluded that there was no special justification for the intravenous use of the drug. Its chief use is in the treatment of children.

Silver Derivatives.—Various silver derivatives of arsphenamine are on the market, and although they offer a new therapeutic means, their status is still undetermined. There are a high incidence of dermatitis and a remote possibility of argyria after their use, but they are believed by some to possess special curative properties in neurological and bone syphilis.

Silver salvarsan is a complex combination of the disodium salt of dioxydiamino-arsenobenzol with silver oxide, with the composition of $Ag_2O.2(NH_2(ONa)C_6H_3As)$. It is a brownish black powder which contains approximately

20 per cent arsenic and 14 per cent silver, and is easily soluble in cold water, with an alkaline reaction. The drug being unstable when exposed to the air, the ampules should be tested for minute cracks in the glass, as before described, and the contents of damaged ampules should not be used.

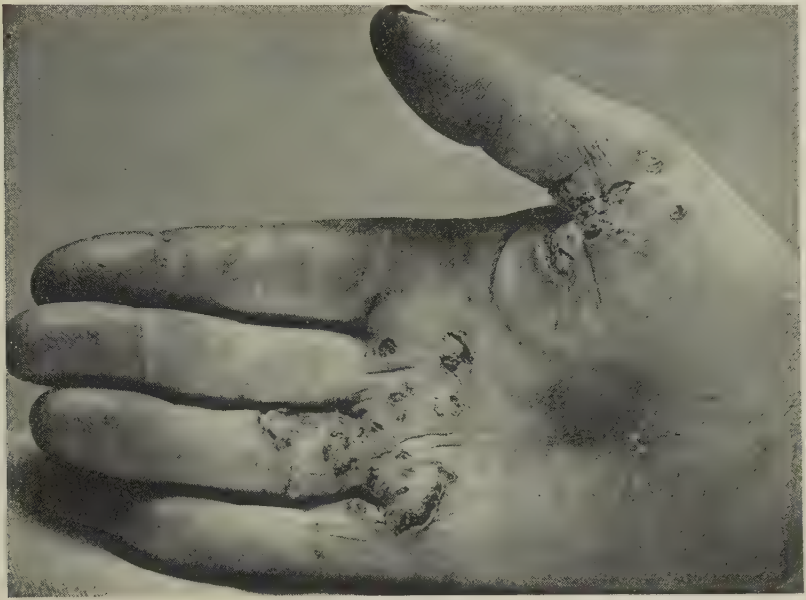

Fig. 658.—Ulcerative serpiginous tertiary syphilide. (Courtesy of Dr. Howard Fox.)

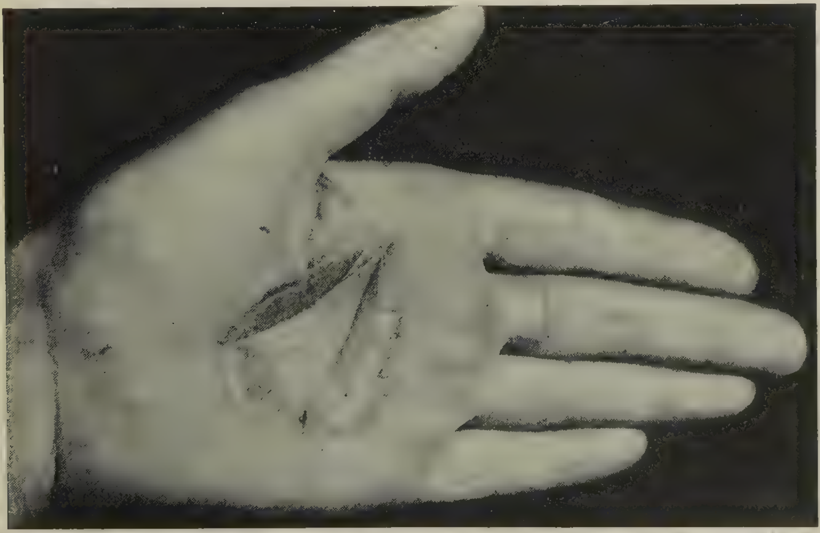

Fig. 659.—Tertiary palmar syphilide. (Courtesy of Dr. Mihran B. Parounagian.)

Preparation.—Silver salvarsan is used intravenously. The solution is prepared by sprinkling the contents of the ampule upon the surface of 5 cc. of cool sterile distilled water contained in a sterile flask. The drug goes into solution rapidly and completely, producing a solution that resembles that of colloidal silver. Hot water should not be used, as the drug is rapidly decomposed by heat. After the powder has dissolved, sufficient cool 0.4 per cent sterile saline solution is added to bring the quantity of solution up to 20 cc. of liquid per decigram of the drug. The solution is then filtered through previously moistened sterile gauze and, immediately after its preparation, it is injected very slowly by the gravity method, consuming at least three minutes. Cloudy solutions should be discarded.

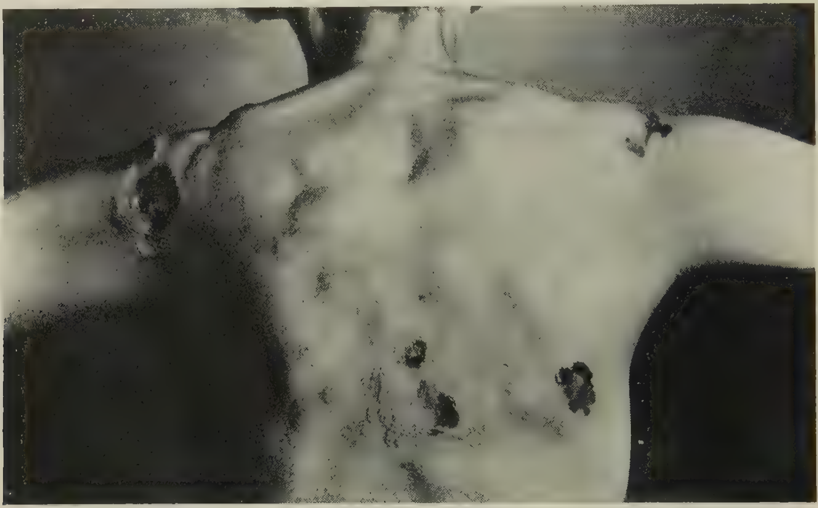

Fig. 660.—Deeply ulcerating serpiginous tertiary syphilis of skin, showing areas of healing.

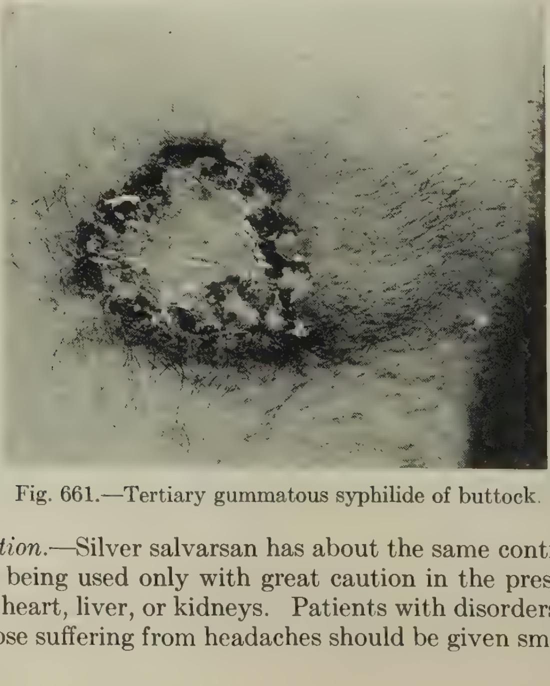

Fig. 661.—Tertiary gummatous syphilide of buttock.

Administration.—Silver salvarsan has about the same contraindications as arsphenamine, being used only with great caution in the presence of organic diseases of the heart, liver, or kidneys. Patients with disorders of the nervous system and those suffering from headaches should be given small initial doses, such as 0.05 Gm. It is advisable not to use mercury simultaneously with the administration of silver salvarsan but it may be given after a course of the latter has been completed. Bismuth and iodine preparations may be given at the same time with silver salvarsan, if desired.

Bismuth.—Although bismuth is a less powerful spirillicide than arsphenamine, it exerts a steady and much greater influence upon syphilis than mercury, and so has become the second most important drug in the treatment of the disease. According to Milian, if the therapeutic efficiency of arsphenamine is represented by the figure 10, that of bismuth corresponds to 7 and that of mercury to 4. In other words, bismuth is regarded as a very effective antisyphilitic remedy both as an adjunct to arsphenamine, and by itself whenever the arsphenamines are contraindicated or not tolerated. Given intramuscularly, it is a relatively safe drug, being less toxic than mercury. The most common complication is stomatitis, preceded by fetor, and a bismuth line in the gums, which, as Hopkins has pointed out, is broader and less sharply defined than that of lead. Mild renal irritation may occur.

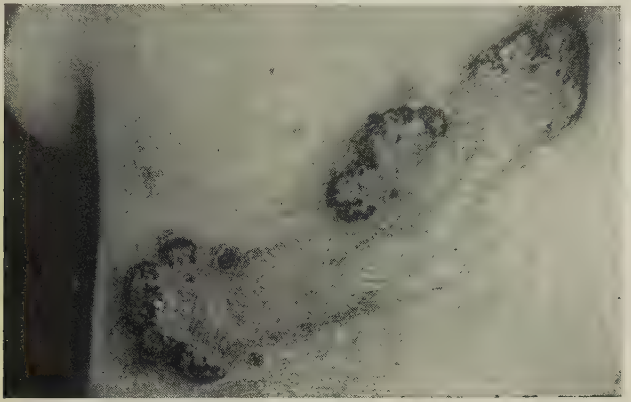

Fig. 662.—Ulcerated tertiary syphilide of the back with zosteriform arrangement. Note scarring and depigmentation. (Courtesy of Dr. Mihran B. Parounagian.)

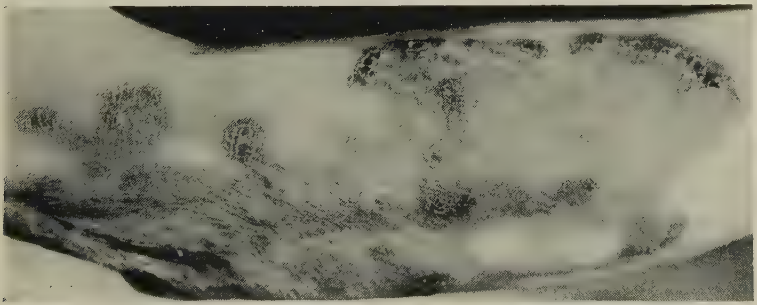

Fig. 663.—Tertiary syphilis. Serpiginous lesion of forearm, showing ulceration in some portions with other areas of involution, scarring, and pigmentation.

Bismuth is advocated in preference to mercury for the treatment of syphilis and while the arsphenamines are the best drugs for intensive therapy of early syphilis, bismuth has a continuous effect, which is highly desirable in the control of a disease so liable to relapses. The influence upon the Wassermann reaction is generally conceded to be less than that of the arsphenamines, but that it has a definite potency to reduce positive to negative tests has been thoroughly demonstrated. Treatment with bismuth is cumulative in effect as shown by radiographic studies of the retention of bismuth salts injected intramuscularly, as made by Cole.

The sodium potassium tartrate of bismuth is commonly employed, although Hopkins states that precipitated bismuth has a higher therapeutic index. Other salts such as the salicylate, the hydroxide, and the iodoquinate are used. The salts contain about 50 per cent of metallic bismuth and are injected once weekly in doses of 0.2 to 0.25 Gm. Such a salt may be given at the same time as arsphenamine or iodides, or in alternate courses with mercury.

Good results have been reported by foreign syphilologists from the use of colloidal bismuth (bismuth diasporal), which is given intravenously or intramuscularly. In this country Klauder has made extensive investigations of the influence of intravenous injections of bismuth compounds both clinically and in the treatment of experimental syphilis in rabbits. The effects were more pronounced than when the bismuth was injected intramuscularly and compared favorably with those obtained with arsenicals. He used colloidal bismuth hydroxide and colloidal bismuth phosphate.

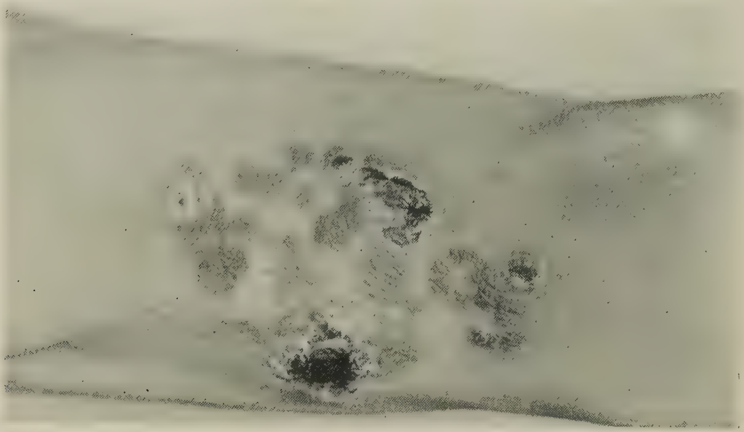

Fig. 664.—Polycyclic gummatous ulcerated syphilide of medial surface of arm.

Following experiments on rabbits, Hopkins made observations on the administration of sodium and potassium tartrobismuthate in early active human cases of syphilis and found it accomplished at least a temporary apparent cure. In latent cases the results suggest that bismuth may be useful in the treatment of those who are resistant to other drugs. A number of patients gave a weakened complement fixation reaction after their first series of bismuth injections and then had a relapse in spite of subsequent treatment. There were, however, several cases in which considerable treatment with arsphenamine and mercury had exerted no apparent influence, but which showed the first break in their series of four plus reactions after taking bismuth. There were also one or two patients that had relapsed to a weak positive after previous treatment and who seemed more definitely influenced by bismuth.

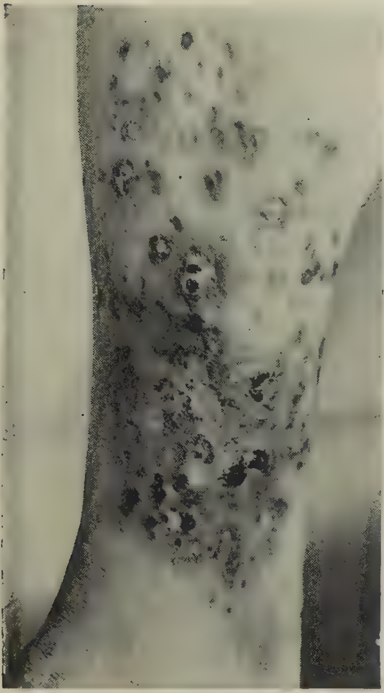

Fig. 665.—Destructive tertiary nodular syphilide.

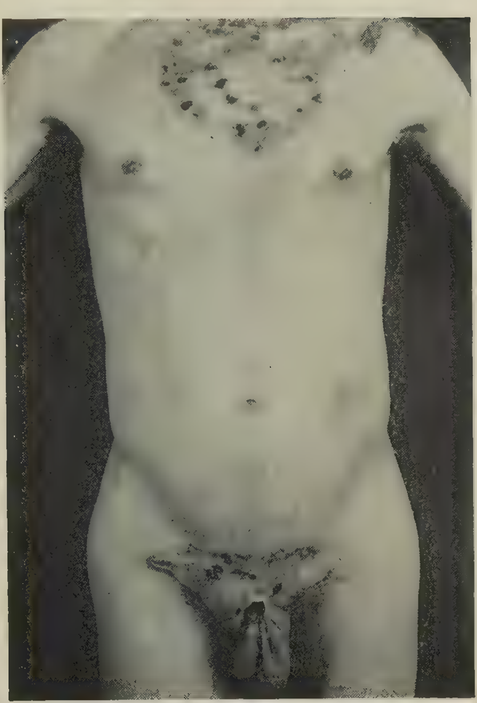

Fig. 666.—Tertiary nodular syphiloderm with gummatous destruction of penis. (Courtesy of Dr. Mihran B. Parounagian.)

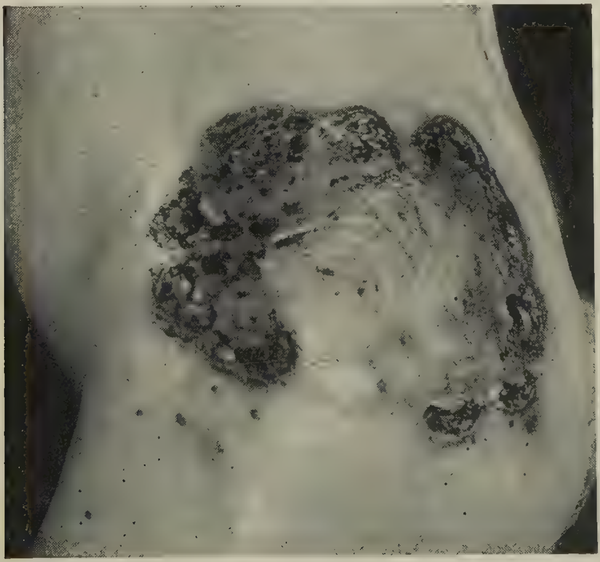

Fig. 667.—Extensive deeply ulcerated tertiary syphilide located on hip. (Courtesy of Dr. Mihran B. Parounagian.)

Intramuscular injections are usually given once weekly, alternating first on one buttock and then on the other. When insoluble salts are used it is especially important that the injection should not be given in exactly the same spot each time.

Hopkins compares the therapeutic indices of bismuth and other antisyphilitic remedies as shown in Table 32. He demonstrated that potassium and sodium bismuth tartrate was tolerated intramuscularly in doses of 75 mg. per kilogram, whereas the therapeutically active dose capable of healing lesions and causing a disappearance of spirochetes in syphilis in rabbits was 2 mg. per kilogram.

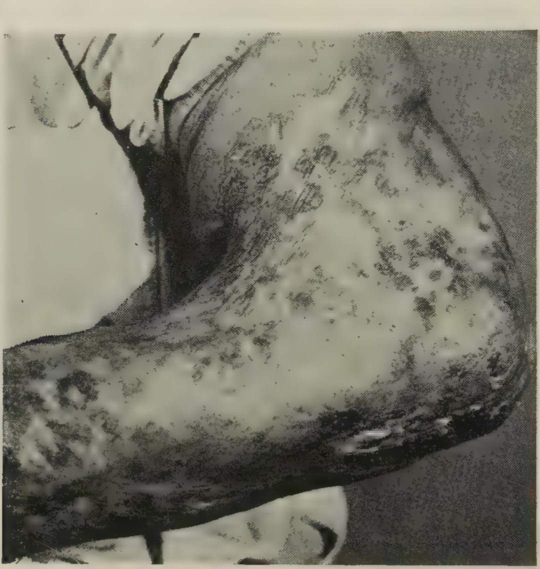

Fig. 668.—Extensive scarring due to tertiary gummatous syphilide of the arm. (Courtesy of Dr. A. Benson Cannon.)

TABLE 32

Preparation.	Curative dose mg. per kg.	Approximate tolerated dose mg. per kg.	Approximate therapeutic index.
Potassium and sodium bismuth tartrate...	2	75	1 : 37
Precipitated bismuth..................	4	400	1 : 100
Arsphenamine (intravenously)...........	15	100	1 : 7
Neoarsphenamine (intravenously).......	11	300	1 : 30
Mercuric salicylate (intramuscularly).....	15	6	2½ : 1

The value of bismuth in arsenic-resistant and mercury-resistant syphilis is commended by Milian, Grund, Klauder, and others. Nicolau and Blumenthal have reported 4 cases of syphilitic reinfection in patients whose first infection had been successfully treated with bismuth exclusively.

Mercury.—The use of mercury in the treatment of syphilis is as old as the cognizance of the disease itself. As pointed out by Stokes, its employment, although subject to approval and disapproval, has been so constant that it cannot be regarded lightly. At present mercury as a remedial agent is suffering a shock from the invasion of bismuth into the therapeusis of syphilis.

Mercury is used by mouth, by inunction, by intramuscular and intravenous injection. Mercury by mouth has no place in the modern treatment of syphilis, but is to some extent used by the older syphilologists in the form of mercury with chalk—1 to 2 grains three times daily in courses of two to three months' duration interspersed by rest intervals of one or two months; the bichloride, the popular soluble salt, is given in doses of 1/32 grain t. i. d. The latter is often combined with potassium iodide in syrup of sarsaparilla for what is called a mixed treatment. The drug should be stopped if ptyalism, stomatitis, cramps, or diarrhea occurs.

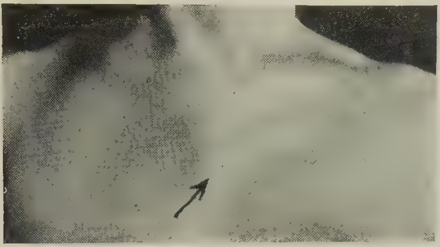

Fig. 669.—Gumma of the sternum. (Courtesy of Dr. Mihran B. Parounagian.)

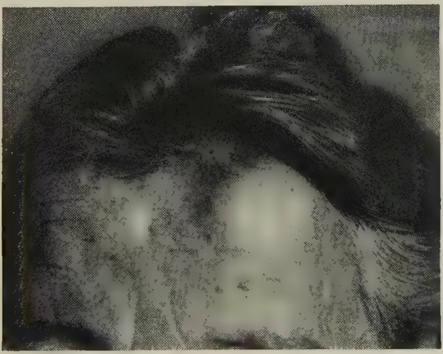

Fig. 670.—Gumma of forehead involving frontal bone. (Courtesy of Dr. Mihran B. Parounagian.)

℞.	Hydrargyri chloridi corrosiv	gr. 1/32	0.002 Gm.
	Potassii iodidi	gr. v	0.32 "
	Syrupi sarsaparillae comp	♍ xx	1.25 "
	Aquae destillat q.s. ad.	ℨj	3.75 "

Mercury Inunctions.—Mercury by inunction has largely been supplanted by the method of intramuscular injection, but it still has a field of service for those patients who for one reason or another are unable to see a doctor frequently. Inunctions are the safest method of administering mercury. They largely avoid cumulative effects and symptoms of gastro-intestinal and renal irritation. The mode of absorption of mercury when rubbed into the skin is still undetermined. It has been proved that most of the absorption occurs about the hair follicles and sweat glands, and it has also been pointed out that some of it is through inhalation. Cole has demonstrated that it is possible to remove the residual mercury ointment from the skin surface by benzine after a vigorous inunction, without losing any appreciable mercurial effect. According to Wile and Elliott, mercury appears in the urine in twelve to twenty-four hours after its application to the skin.

Inunctions are not tolerated by very hairy skins and may produce a dermatitis in others. It is a slow method, which is not suited to the requirements of energetic treatment of early untreated syphilis, but is useful in the interval between courses of arsphenamine. I use the official unguentum hydrargyri (50 per cent metallic mercury ointment) as recommended by Stokes, the same being made up with a cocoa-butter base and supplied in cakes containing from 30 to 50 grains of mercury. Explicit directions to the patient are given by Stokes as follows:

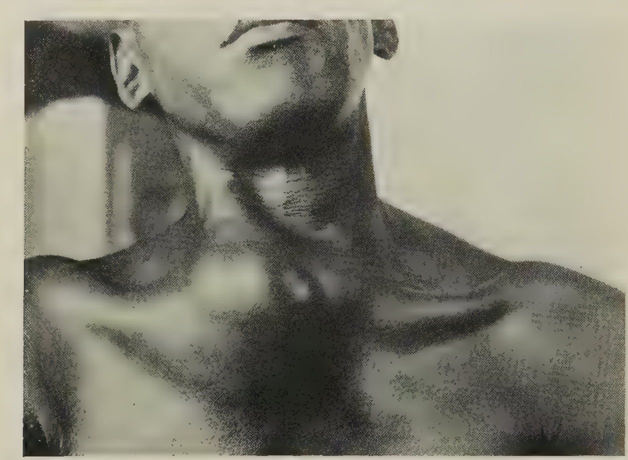

Fig. 671.—Gumma of claviculosternal region, a common location.

> *Instructions for Taking Rubs.*—The medicine used in taking rubs enters the body through the skin. It must never be taken by mouth, or placed where children can reach it.
>
> Rubs are taken in sets of six, one rub every night and a bath in place of a rub on the seventh night. Before rubbing, the skin where the rub is to be taken is to be thoroughly washed with soap and water and dried with alcohol intended for use on the skin. The rub is taken on one of six different places, a different place being used each night. The room in which the rub is taken should be warm.
>
> 1. The first rub is taken on the right-hand side of the chest in front of and below the armpit.
> 2. The second rub is taken on the left-hand side of the chest, in front of and below the armpit.
> 3. The third rub is taken on the right-hand side of the abdomen or on the flank.
> 4. The fourth rub is given on the left-hand side of the abdomen or on the flank.
>
> If there is any hair on the outside of the thighs, the fifth or sixth rubs can usually be taken on the insides of the right and left thighs, respectively. Be careful not to rub where there is hair and do not rub two nights in succession on the same spot. If you are giving the rub to someone else, the back may be used for two or more rubs. Do not rub where there is hair, or the skin will become inflamed. If there is much hair on the body, call your physician's attention to it and ask him to tell you where to rub. Rub for at least twenty minutes *by the clock.* Rub firmly, but not roughly. The skin should not be sore after the rub. Rub in a space of about a foot or 18 inches in diameter. Wipe off any ointment which remains on your hand on to the skin when you have finished.
>
> Powder the skin after rubbing if you wish, but do not attempt to wash off or remove any of the ointment.
>
> Through the entire series of six rubs the patient *should wear the same suit of underwear.* It is better to use old underwear, which will become stained with the ointment. *Don't bathe during the series of six rubs* without special permission from your physician. After

completing the series of six rubs, a bath should be taken on the seventh night in place of a rub. This bath should be with soap and hot water, and all the grayish stain from the rubbings should be removed from the skin. The skin should then be powdered and the patient must change the underwear.

Rubs are usually given in sets of six and *the course of rubs consists of not less than forty,* covering a period of six or seven weeks. During such a course it is important that you should see your physician once in two weeks unless he allows a longer interval. Do not allow yourself to miss or skip rubs during a course without your physician's permission.

While this form of treatment is not pleasant, it is very effective and will do you much more good than the taking of pills or other medicine by mouth. For that reason you should persist in it as long as your physician thinks necessary, even though you may have to take a number of courses. Be sure to report to your doctor any trouble with the mouth or teeth. Your urine should be examined by a physician at least once in two weeks.

The dosage is roughly regulated by the body weight, usually from 1 to 1½ drachms of the unguentum hydrargyri, 50 per cent strength, being used at each inunction given five to six times a week for a course of six weeks with rest intervals of one month between courses. Stokes considers that three hundred rubs are a good series in early syphilis, and that underdosage is a common error.

Cole has modified the usual inunction technic. In this "clean inunction" the patient is permitted to change underwear and bedding and to bathe whenever he desires. The area rubbed is at least 18 inches in diameter and the time longer—thirty minutes by the clock. The excess ointment remaining on the skin, after the rub, is wiped off, and the grayish stain removed with soap and water or with cotton moistened in benzine. In case the latter is used, care must be exercised to avoid fire.

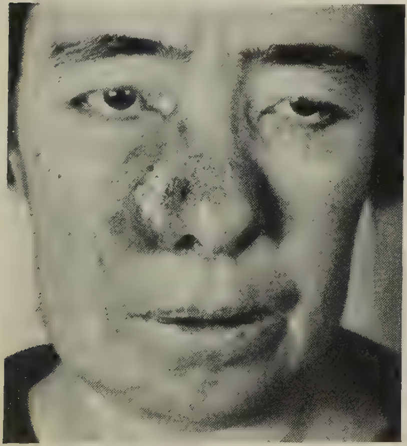

Fig. 672.—Gumma of nose. (Courtesy of Dr. A. Benson Cannon.)

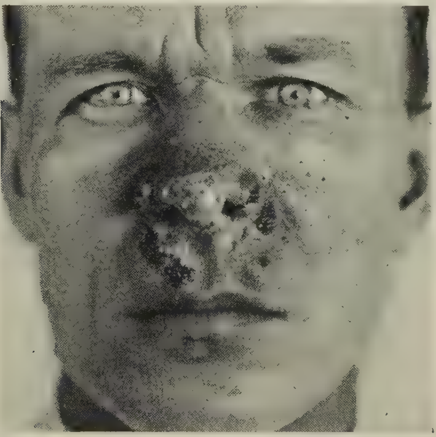

Fig. 673.—Gummatous syphilide of the nose and lip with considerable destruction of the alae nasi.

Intramuscular Injection.—The intramuscular injection of mercury is the most popular means of administration. It is necessary, however, to distinguish between the manifold preparations on the market, for they vary greatly as to solubility, absorbability, and effectiveness. The soluble mercurials in common use are the bichloride, the benzoate, the succinimide, and the red mercuric iodide. These are rapidly absorbed and have a therapeutic effect within a few hours after injection. There is little cumulative effect and the benefit of the injection is temporary, so that frequent administration is necessary. Stokes considers that injections of these soluble salts should be given three to six times weekly, in doses of $\frac{1}{6}$ to $\frac{1}{4}$ grain, and points out that there is a rapid reaction to overdosage—hypersusceptibility to diarrhea or hematuria.

On the other hand, the insoluble salts, such as calomel, metallic mercury, and mercuric salicylate, are so slowly and irregularly absorbed that their use is attended by hazards of prolonged ineffectiveness due to failure of absorption or prolonged overdosage due to tardy absorption. The principal service of the insoluble salts of mercury, as stated by Stokes, is to supply an absorption depot, to keep the patient under the influence of an antisyphilitic drug for a considerable period after active treatment is discontinued. Mercury salicylate suspended in a vegetable oil is the most popular insoluble salt, but Stokes regards its efficiency in the treatment of syphilis as questionable. The dose is from 2 to 3 grains weekly for a course of ten to twelve injections.

The delayed absorption of the insoluble compounds is due to a walling off of the deposits by a growth of fibrous connective tissue. The inflammatory reaction varies in different individuals; most patients tolerate large numbers of injections without the formation of fibrous nodules, but in others fibrous lumps occur so regularly that the injections must be stopped and some other method of administration substituted. Not only are the nodules uncomfortable, but they are also possible sites of abscesses, and of deposits of mercury, which later may be set free with injury to the kidneys.

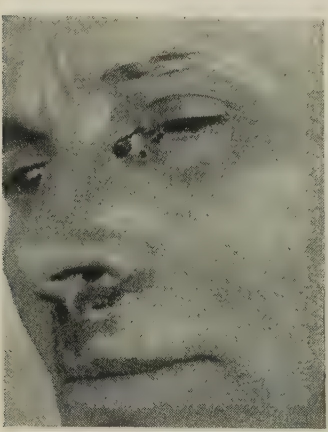
Fig. 674.—Tertiary syphilis of the upper lip and inner canthus of eye with ulceration of the latter lesion.

Mercury is also administered intravenously, but this method has no advantages over the intramuscular route and has definite hazards from irritation of the vessels, kidneys, and intestine.

Tryparsamide.—Tryparsamide is a pentavalent arsenical, being structurally one of a group which seems to have a selective action on the optic nerve. It is the sodium salt of N-phenylglycinamide-p-arsonic acid. Tryparsamide is a white crystalline powder, soluble in water and, under ordinary conditions, stable. It has a powerful parasiticidal action which is more intense in the case of trypanosomes than spirochetes, the drug having its best effect in African sleeping sickness. Tryparsamide has unusual penetrative qualities which are of importance in syphilis of the central nervous system. It is eliminated rapidly, so that cumulative toxic effects are absent.

The best results in syphilis have been in meningovascular syphilis, general paresis, taboparesis, and tabes dorsalis. However, the drug should not be given in advanced neurosyphilis with marked mental and physical deterioration, because little or nothing can be accomplished in this stage of the disease and its use may produce more rapid degeneration. Tryparsamide has also been shown to be of little value in uncomplicated cases of primary, secondary, and tertiary syphilis. For these reasons its utility is limited to the early cases of neurosyphilis, especially those of general paresis.

Special precautions must be taken in the selection of patients for treatment with tryparsamide, but this should not be construed as a ban against it. Before its administration, a thorough neurological examination, and an investigation of the blood and spinal fluid, and of the physical status are necessary. The principal contraindications are a reduction in the acuteness of vision or a concentric contraction, or sector-shaped peripheral defects of the visual field. These are the early symptoms of primary atrophy of the optic nerve, the ophthalmoscopic sign of which is a white disk with sharply defined regular edges. Tryparsamide has a toxic action upon the optic nerve and may produce blindness in persons who have early symptoms or signs of optic atrophy. Amblyopia has occurred in patients when the injections were given during the early stages of optic atrophy. Subjective temporary disturbances of vision are not uncommon in patients being treated with this drug. The visual fields and acuity should be examined before each injection and when they are impaired, administration of the tryparsamide should be discontinued until the disturbance has subsided. The eye symptoms usually disappear upon cessation of the treatment. Other contraindications to its use are similar to those of the other arsenicals, but, as before stated, care must be exercised not to employ the drug in patients who already have marked physical and mental deterioration.

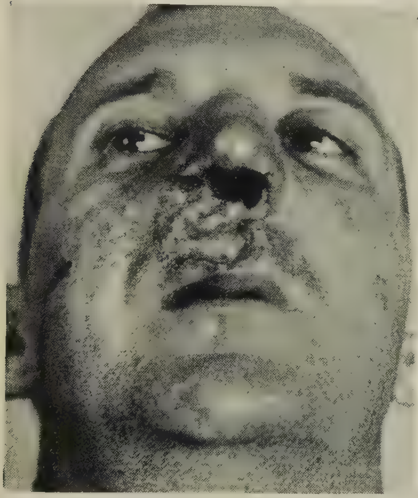

Fig. 675.—Gummatous syphilide of lip and nose with marked destruction of the ala and septum.

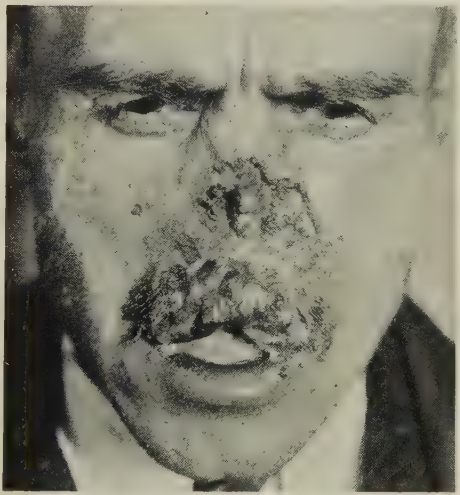

Fig. 676.—Ulcerative gummatous syphilide of nose and lip. (Courtesy of Dr. A. Benson Cannon.)

Administration.—Tryparsamide is administered intravenously by the syringe method, the drug being dissolved in sterile distilled water of room temperature, 1 to 3 Gm. in 100 cc. volume. The freshly prepared solution should be clear and should be filtered before use in order to remove any mechanical impurities. Turbid solutions should not be used. The dose of tryparsamide for adults is from 1 to 3 Gm., repeated at weekly intervals for a series of eight to ten injections. In general, the dose should not exceed a maximum of 0.04 Gm. per kilo of body weight weekly. Treatments may be given at weekly intervals in courses of five to seven injections.

Tryparsamide may be used in conjunction with arsphenamine and mercury. A common practice is to administer tryparsamide and arsphenamine alternate weeks. Tryparsamide seems to change the serology of the spinal fluid more rapidly and effectively than any other drug used in paresis. Unfortunately clinical improvement does not always run parallel with that of the spinal fluid, but nevertheless in the early stages of paresis favorable clinical response has been obtained.

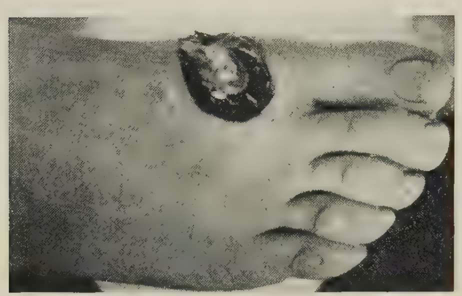

Fig. 677.—Gumma on dorsum of foot. Note punched-out appearance. (Courtesy of Dr. Mihran B. Parounagian.)

Iodides.—Whereas the iodides have no specific effect upon the organism which causes syphilis, they exert valuable action in removing gummatous infiltrations and in healing tertiary skin lesions and syphilis of the bones, periosteum, and of the nervous and cardiovascular systems. The iodides produce no definite changes in the Wassermann reaction.

Potassium iodide and sodium iodide are the commonest salts employed, in doses ranging from 10 to 30 gr. by mouth three times daily. Rarely are larger amounts well tolerated, and in those who have an idiosyncrasy for the drug small amounts may produce toxic symptoms. The effect of the iodides probably is enhanced by the use of a salt-poor diet and, according to some observers, by the simultaneous administration of a mercurial, the combination being termed "mixed treatment."

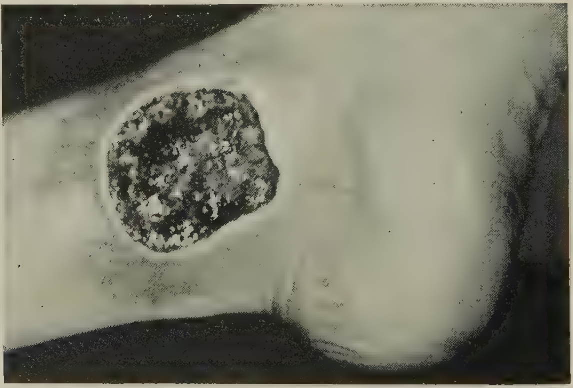

Fig. 678.—Deeply ulcerated gumma of ankle. Note punched-out appearance. (Courtesy of Dr. A. Benson Cannon.)

℞.	Hydrargyri chloridi corrosivi	gr. 1/20	0.003 Gm.
	Potassii iodidi	gr. x	0.64 "
	Tinct. calumbae q.s. ad.	ʒj	3.75 "

M. and S. ʒj t. i. d., p.c. in water.

℞. Potassii iodidi,
Aquae destillat . . . . āā 30

M. and place in brown dropper bottle.
Sig. Ten (10) drops in water or milk t. i. d., p. c.

Administration.—Iodides may be administered intramuscularly in the form of iodopin, which is a mixture of iodine and oil, or intravenously in the form of sodium iodide solution. These methods of administration have only slight advantages over the oral use of the drug in persons who are susceptible to it. When the stomach becomes upset from taking iodides by mouth, they are better tolerated if a glassfull of milk is given at the same time. Sodium iodide has the reputation of being less irritating to the stomach than potassium iodide. The toxic effects are known as iodism and consist of skin eruptions, coryza, nausea, and abdominal cramps. The skin lesions are of various types —urticaria, angioneurotic edema, acneiform eruptions, erythema nodosum, and fungating tumors.

Other Remedies.—Kemp and Stokes, after a study of 65 cases of syphilis treated by fever induced by bacterial proteins, conclude that fever therapy combined with arsphenamine therapy and followed by arsphenamine and bismuth, offers a somewhat more satisfactory therapeutic outlook than routine arsphenamine and bismuth therapy alone.

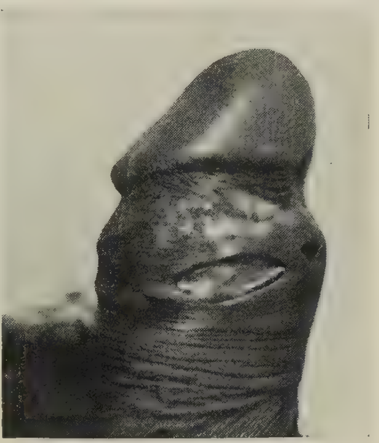

Fig. 679.—Gumma of penis.

The value of *nonspecific protein therapy* in the treatment of disease is still undetermined, but there have been good results reported in all stages of syphilis. The most outstanding nonspecific treatment at present is by malarial inoculation. By the experimental work of Wagner von Jauregg the malarial treatment has been widely applied to syphilis in recent years, and the general consensus of opinion is that it is without value in early cases, and that its benefits in late syphilis of the nervous system are proportionate to the height of the febrile reaction produced. In other words, *malarial therapy* seems to rest upon nonspecific grounds. It has achieved the best results in the early stages of paresis, although statistics in this connection are so con-

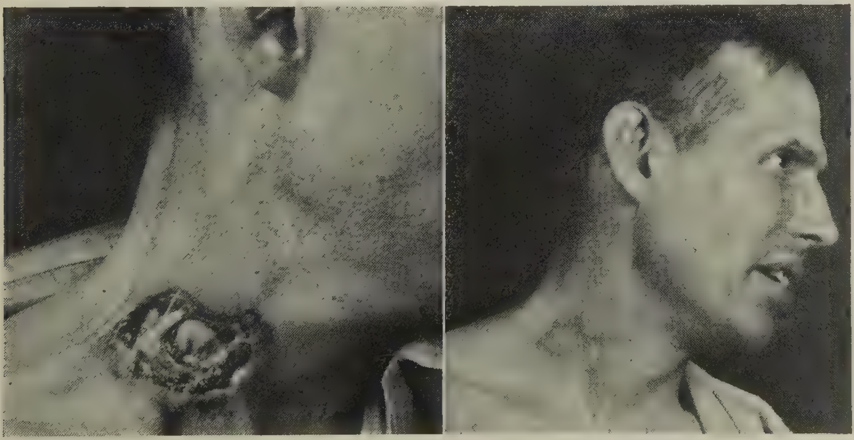

Fig. 680.—Ulceration with deeper structures exposed.

Fig. 681.—Same patient after treatment.

Figs. 680, 681.—Gumma of the neck. (Courtesy of Dr. Mihran B. Parounagian.)

tradictory that final evaluation is impossible. The good results are somewhat offset by the mortality caused by the treatment, averaging about 3 per cent.

General Treatment.—Syphilis is a relapsing and wasting disease, and syphilitics in the course of time fare better and respond better to treatment if attention is given to the general health. This aspect of therapy is as a rule not sufficiently emphasized.

Unparalleled therapeutic results are attained in early cases if the patients pay strict attention to abstinence, moderate and regular outdoor exercise and sleep. Excesses of all kinds should be avoided. The diet should be nutritious and ample in carbohydrates.

Oral cleanliness with special attention to the care of the gums and teeth is important. The dentist should be consulted at least every three months, and the gums should be treated more often if there are evidences of pyorrhea.

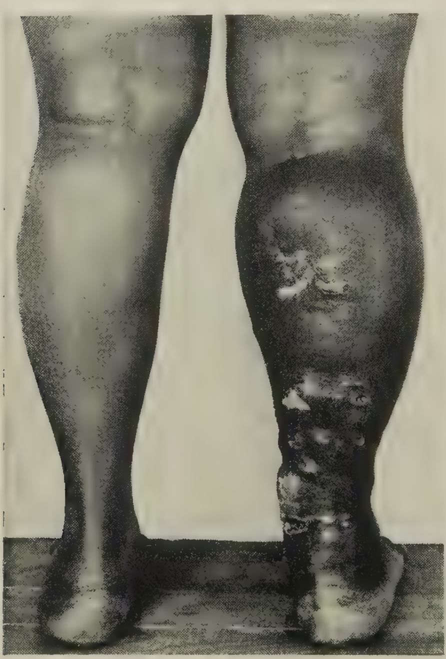

Fig. 682.—Gummata of leg.

The skin should be watched for evidences of irritation, as eruptions may be produced by most antiluetic remedies. Patients who have eczema, xerosis, seborrheic dermatitis, or other skin diseases are especially susceptible to drug eruptions, and their skins should be protected against external irritation or hyperemia produced by hot Turkish baths.

The functions of the kidneys and liver require constant observation, and deleterious effects upon these organs may be avoided by attention to elimination.

The mental attitude of the syphilitic is an important feature and should always be considered, as it may present some opportunity for improvement. Practically all sufferers from the disease develop depressions, anxiety neuroses, or feelings of inferiority. The behavior of the syphilitic morally and in relation to prolonged expensive and painful courses of treatment depends to a large extent upon his mental attitude toward the infection, which is likely to be distorted and which it is the duty of the physician to make sensible and hopeful.

Local Treatment.—On account of the early spreading of organisms from the point of infection to the lymph glands and blood stream, local treatment of the primary sore is relatively unimportant. In fact, it is necessary to avoid local antiseptics in early cases until the clinical diagnosis has been substantiated by dark-field examination or Wassermann test, only wet dressings of normal saline solution being applied. After confirmation of the clinical diagnosis, the chancre disappears as the result of intravenous injections of arsphenamine. After positive diagnosis, there is no objection to local antiseptics such as calomel powder or 5 per cent ammoniated mercury ointment or wet dressings of aqueous bichloride of mercury, 1 : 2000. In the treatment of "mixed infections" due to a combination of the Ducrey bacillus with the Treponema pallidum, the mixed sore should be treated locally as a chancroid after the diagnosis has been proved and arsphenamine therapy begun.

Local treatment of pustular and ulcerative syphilides with ammoniated mercury ointment hastens their involution; consequently these measures should supplement arsphenamine therapy. At times the healing of tertiary ulcerations is delayed by the presence of pyogenic infection or exuberant granulations, and in such an event strict local cleanliness and even cauterization may expedite healing.

Scheme of Systemic Treatment.—In its early stages syphilis is best treated by courses of arsphenamine alternating with courses of bismuth or mercury. The most important drug is arsphenamine and it should be used as much as toleration permits. In the later stages less emphasis is placed upon intensive arsphenamine treatment, but at all times it is the outstanding therapeutic method.

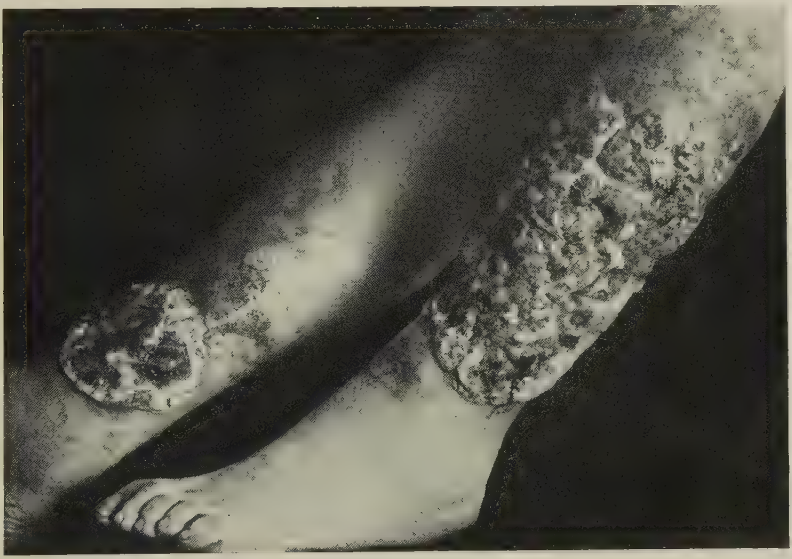

Fig. 683.—Gummatous ulceration of both legs. Lesions of four years' duration. Note hypertrophic features. (Courtesy of Dr. Mihran B. Parounagian.)

There is at present a tendency to give continuous treatment without rest intervals. As a rule, in healthy young adults the more treatment given, the better it is, preference being shown for moderate dosage at frequent intervals. The individual tolerance for arsphenamine varies; I had one patient who took 0.45 or 0.6 Gm. of neoarsphenamine regularly each week for two and a half years without the slightest discomfort and with great improvement. This patient had tabes dorsalis, severe gastric crises, and completely positive serology. Since treatment he has been free of symptoms, and all tests on blood and spinal fluid are now negative. Other subjects do not tolerate the drug well and have reactions in spite of every precaution. Patients seem to tolerate arsphenamine better if it is the only drug used. When mercury injections or inunctions are given simultaneously with arsphenamine, there is supposed to be greater incidence of dermatitis and nephritis. The associated administration of mercury may lessen the elimination of arsenic by disturbing the function of the kidneys. To avoid injury from the simultaneous use of arsenic and mercury, it may be advisable to give them in separate courses, and bismuth may be employed in a similar manner.

The treatment of syphilis should not only be continuous but prolonged. The syphilitic cannot be discharged as cured, because there are no criteria of cure. The limitation of the syphilitic process is undetermined. After the serology has remained negative for several years, in the absence of clinical signs of activity of the disease, treatment may be mitigated, but each year a Wassermann test should be made.

Treatment During the Primary Stage Before the Wassermann Test Has Become Positive.—As soon as the diagnosis of syphilis has been established, active treatment should be instituted. The best opportunity to treat the infection successfully is during the chancre period, before the appearance of the roseola or a positive blood test. There is usually an interval of two or three weeks between the appearance of the chancre and the manifestation of a positive blood Wassermann test. During this period the arsphenamine should be used intensively or other antisyphilitic remedies should be given. The arsphenamines act promptly and potently, causing a rapid disappearance of spirochetes from the initial lesion, producing a sterilization of the patient, and preventing the Wassermann test from becoming positive. As the possibility of a cure by thorough treatment begun during this period is excellent, the Herxheimer reaction should be disregarded, and no time should be lost by attempting mercurialization. For average persons arsphenamine may be given daily in doses of 0.4 Gm. for the first three consecutive days, and after that the injections may be given twice weekly for two weeks, followed by weekly injections until a total of twelve doses has been given. During this intensive therapy the principal danger is jaundice, and the patient should therefore be carefully advised regarding elimination and diet. At the first sign of icterus, or tenderness or complaint of a feeling of fulness in the right hypochondrium, the injections should be stopped and the icterus blood index test should be made.

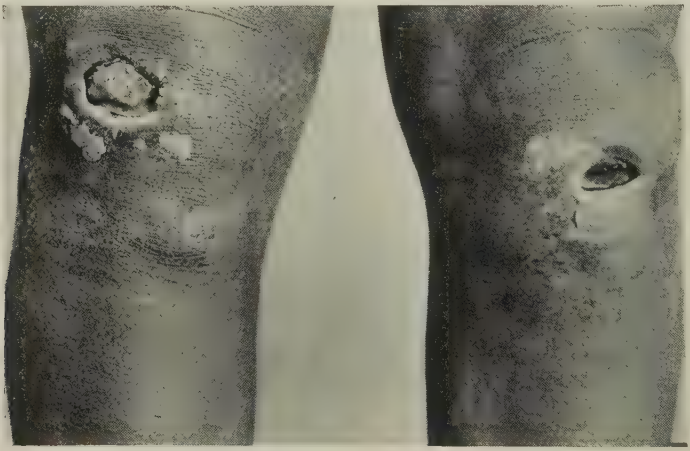
Fig. 684.—Ulcerated indolent gummata of both knees.

Following the arsphenamine injections, a course of bismuth or mercury injections should be given, extending over a period of twelve weeks and beginning in the case of bismuth by weekly injections, when the course of arsphenamine has reached the point of reduction from semiweekly to weekly injections. In other words, when this first course of arsphenamine is reduced to weekly injections of the drug, there should also be instituted a course of bismuth to be given intramuscularly weekly.

Following this therapy, without any intermission, the arsphenamine course and the mercury or bismuth course should be twice repeated, the sole change being that the arsphenamine is given only once weekly. This plan of treatment for the primary stage of syphilis is an intensive effort to produce complete eradication of the disease. It comprises a minimum of thirty doses of arsphenamine and thirty-six doses of bismuth or mercury and continuous treatment over a period of one year. During this period the blood Wassermann reaction must be regularly examined. It sometimes becomes positive after the first few injections, probably because the infection had already progressed extensively before the first injection was made. A spinal fluid examination should be made upon every patient at the end of the first course of treatment regardless of the absence of symptoms. Active treatment with arsphenamine and bismuth must be continued during the second year, at least two courses of ten injections of each drug being given. Those who have been successfully treated in the primary stage must be observed regularly every three months for two years after the completion of their active treatment, and before they are discharged as cured there should be a repetition of the spinal fluid examination.

In primary syphilis, with a positive Wassermann reaction, the patients should be treated the same as in early secondary syphilis.

Treatment in the Secondary Stage.—In the primary stage with a positive Wassermann reaction and in the secondary stage, complete sterilization by the intensive method is more difficult than earlier in the course of the disease. On account of the generalization of the infection more attention is paid to the Herxheimer reaction, and to combined treatment by arsphenamine and either bismuth or mercury. The institution of arsphenamine treatment is preceded by mercurialization in all cases in which the patients have headaches or other symptoms of neurological involvement. In these patients two consecutive daily injections of mercury salicylate should precede arsphenamine treatment, but this precaution may be omitted in patients who have no such symptoms and have infectious mucous membrane lesions. In the latter group arsphenamine injections are begun immediately upon establishment of the diagnosis. In all cases during the secondary stage arsphenamine injections are given once weekly until some intolerance is shown. Preferably these injections are continued for one year without interruption. During the arsphenamine therapy weekly injections of bismuth also may be made. In those who tolerate arsphenamine well, there is some question as to whether better results are not obtained by the continuation of weekly arsphenamine injections over a long period without the concomitant use of either mercury or bismuth. After the first year of active treatment a rest interval is given for three months and then courses of arsphenamine and bismuth or mercury are begun. Throughout the second year, the injections are given in courses of twelve, followed by rest intervals of twelve weeks. In the rest intervals between these courses mercury is given by inunctions or intramuscular injections over a period of twelve weeks. The doses of arsphenamine may be larger when they are few in number than when they are given weekly over a long period, in which case they should be 0.4 Gm. for the average man, and 0.3 Gm. for the average woman.

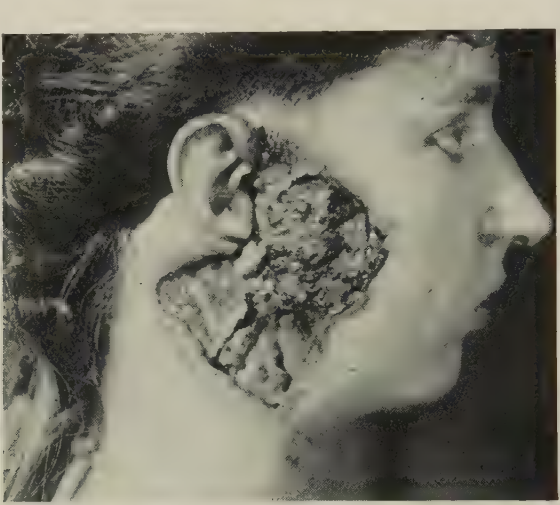

Fig. 685.—Extensive gumma in a case of congenital syphilis which was treated by several physicians under the diagnosis of sarcoma. (Courtesy of Dr. Nathan T. Beers.)

Duringthe first year that secondary syphilis is under treatment a Wassermann test should be made every three months and a spinal fluid examination should be made at least once.

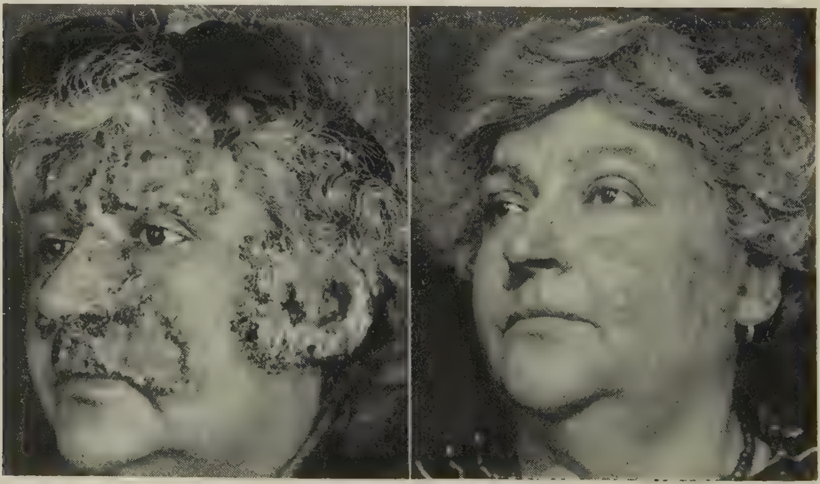

Fig. 686.—Appearance before treatment. Fig. 687.—Result after treatment.
Figs. 686, 687.—Widespread superficial ulcerative gummatous syphilide of the skin. (Courtesy of Dr. Mihran B. Parounagian.)

After the completion of the second year of treatment there is a rest interval of six months during which the patient is given potassium iodide by mouth, and is observed once for a Wassermann reaction. The minimum amount of therapy advisable for patients in the secondary stage may be estimated at sixty arsphenamine injections, sixty bismuth injections, and thirty-six mercury injections or 150 inunctions, or 100 arsphenamine injections alone, over a period of two and one half years.

There can be no definite rule established for the number of treatments that any given patient should have because this is influenced by the history and physical condition. To a large extent the serology serves as an index of therapeutic requirements, but it is important to realize that a negative blood test has less significance than a positive one in this respect. As long as the reaction is positive treatment should be unmitigated if it is well tolerated, but if the Wassermann test becomes negative, treatment must be continued until the patient has had the minimum amount of therapy advised above. A lapse of treatment because the Wassermann reaction is negative after a brief course of injections is commonly followed by a recrudescence of a positive test.

The spinal fluid should be examined during the first year of treatment. After two and a half years of active treatment, if the serology is negative the patient should be examined clinically and serologically at intervals of six months for two additional years, and if there is any sign or symptom of the disease, treatment should again be instituted. If at the end of two years after the cessation of treatment, *i. e.*, four and one half years after secondary eruption, these examinations are still negative and the spinal fluid examination is repeated and found negative, the patient may be considered cured so far as scientific knowledge permits the use of the word, and he should thereafter report once yearly for physical examination and blood Wassermann test.

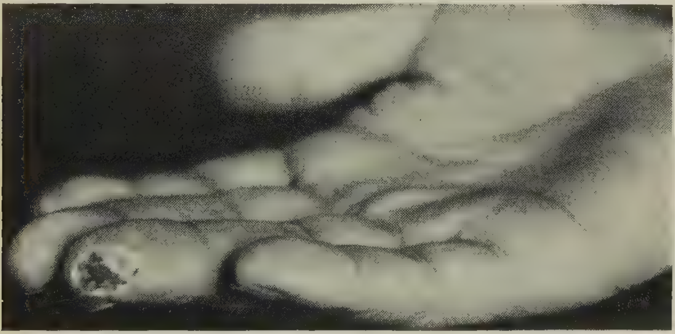

Fig. 688.—Gumma of tip of finger. (Courtesy of Dr. Mihran B. Parounagian.)

Treatment in the Tertiary Stage.—For patients in the tertiary stage of syphilis there is but little hope of eradicating the disease, and the aim of the treatment is to control any activity of spirochetes and to build up the resistance of the individual. By this time structural changes are likely to have occurred in various organs and these prevent intensive treatment and limit therapeutic efforts to conservative practices. In general, the treatment employed consists of courses of weekly injections of moderate doses of neoarsphenamine for eight to ten weeks followed by courses of bismuth or mercury and iodides. At this stage of the disease it is a mistake to attempt to produce a negative serology, without due regard to the injuries to the patient's organs that may be caused by the injections of the drugs. Many patients over fifty with involvement of the nervous system or viscera would be injured and have their lives shortened by too vigorous treatment of cutaneous lesions or of positive serological manifestations.

The iodides and mercury have valuable and ancient rôles in the treatment of tertiary syphilis. Moderate treatment with these drugs, and the use of neoarsphenamine and bismuth when there is activity of the disease are a desirable method to pursue. The iodides have a nonspecific action upon the disease and, therefore, should not be solely trusted to arrest its progress. Their effects are best in late parenchymatous syphilis or in tubercular or gummatous lesions. The iodides hasten the healing of those under antiluetic treatment, but they do not prevent recurrences or eradicate the disease. The iodides are therefore combined with mercury and in the form of "mixed treatment," which has been previously described, have a specially good effect in late syphilis.

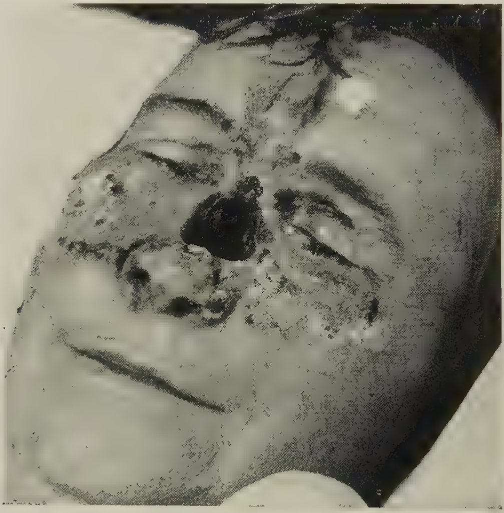

Fig. 689.—Extensive gummatous syphilide of the face with destruction of the deep structures of the nose. (Courtesy of Dr. Mihran B. Parounagian.)

Treatment of tertiary syphilis of the tongue is discussed separately on page 991.

Influence on Wassermann Reaction.—The influence of mercury upon the Wassermann test is beneficial, but slight, never apparently being sufficient to cause complete reversal from positive to negative. The most powerful influence is exerted by arsphenamine and neoarsphenamine. The effectiveness is greater in the primary and secondary stages of the disease, being less in late syphilis. Silver arsphenamine and sulpharsphenamine have similar properties. Bismuth seems more effective upon the Wassermann reaction than mercury and less so than the arsphenamines.

Treatment of Neurosyphilis.—In the routine treatment of neurosyphilis the method is similar to that of tertiary syphilis in other parts of the body, consisting of weekly injections of one of the arsphenamines together with large doses of the iodides. Because of the hazards of a Herxheimer reaction in some parts of the nervous system, arsphenamine treatment should be preceded by a course of injections of bismuth or mercury, mercurial inunctions, or iodides. Except in young and vigorous subjects, neoarsphenamine is of more general use than arsphenamine. The penetration of drugs into the nervous tissue is hindered by its slight vascularity. Sulpharsphenamine theoretically possesses an advantage over other arsenicals in this respect because of its greater penetrability. Tryparsamide also has an unusual therapeutic penetration.

Spinal Puncture.—One of the most important recent advances in the diagnosis, treatment, and prognosis of syphilis has been the introduction of a routine examination of the spinal fluid early in the course of the disease. This procedure makes possible the early diagnosis of involvement of the central nervous system, so that adequate treatment can be given to control the invasions of the disease before it has damaged essential structures. The technic of spinal and cistern puncture has already been described on pages 728 and 732.

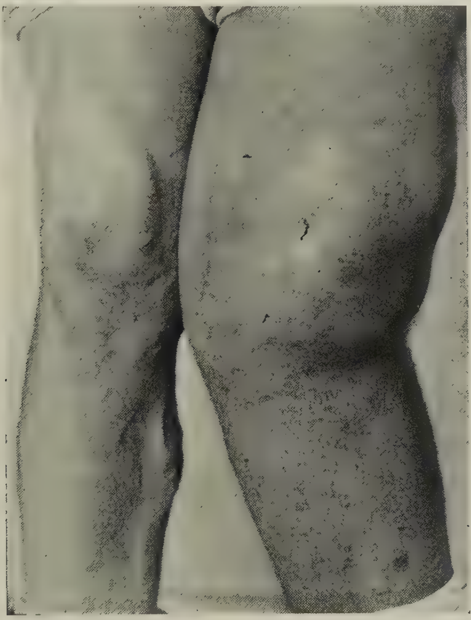

Fig. 690.—Charcot's joint of the knee in tertiary syphilis.

Interpretation.—The spinal fluid examination is composed of five tests: The Wassermann reaction; cell count; the globulin test; the colloidal gold reaction, and measurement of the spinal fluid pressure. The interpretation of the results of each test has already been discussed separately, but their appraisal collectively is of equal weight. Neurosyphilis, especially in treated cases, can exist even if all these tests are negative. Such cases are usually of the vascular type. Changes commonly found in tabes are: Wassermann reaction, 2+ to 4+ in 0.2 cc.; cell count, 20 to 60; globulin, positive; colloidal gold reaction, luetic curve; spinal fluid pressure increased. In paresis the spinal fluid Wassermann reaction is generally a little stronger than in tabes, although the results of this test are about the same in each disease. The cell count may be low or high, depending to a large extent upon the amount of associated inflammation of the meninges; the globulin test is positive, the colloidal gold reaction gives a paretic curve and the spinal fluid pressure is increased. In syphilitic meningitis the spinal fluid Wassermann reaction is usually 3+ or 4+; the cell count, 800 to 1600; the globulin test, strongly positive; the colloidal gold reaction, a strong curve in the first zone (paretic type); the spinal fluid pressure markedly increased. In gumma of the brain the spinal fluid changes are not characteristic but, as a rule, there are a positive Wassermann reaction and pleocytosis.

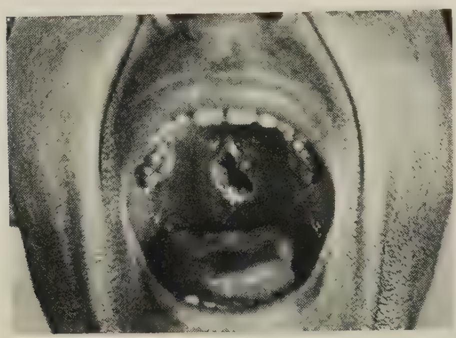

Fig. 691.—Perforating gumma of hard palate.

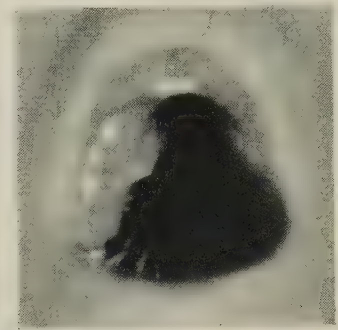

Fig. 692.—Almost complete destruction of palate in tertiary syphilis. (Courtesy of Dr. Mihran B. Parounagian.)

Spinal Treatment.—In those cases of neurosyphilis which do not respond to the usual intravenous and intramuscular therapy, intraspinal treatment is sometimes beneficial. The intravenous method should be given a thorough trial, however, in every case before recourse to intraspinal therapy. Spinal drainage, which is simply the withdrawal of an unusually large amount of fluid by lumbar puncture, produces a deficiency which is largely replaced by transudation of fluid from the blood. Reduction of the pressure of the cerebrospinal fluid is in itself of therapeutic advantage in the treatment of some cases. In neurosyphilis reliance is placed upon the transudation of drugs from the blood into the spinal canal or upon the introduction of small quantities of arsphenamine or mercury directly into the canal. Following are some of the methods in common use.

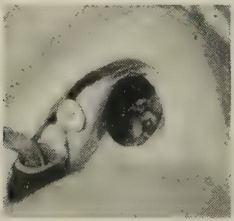

Fig. 693.

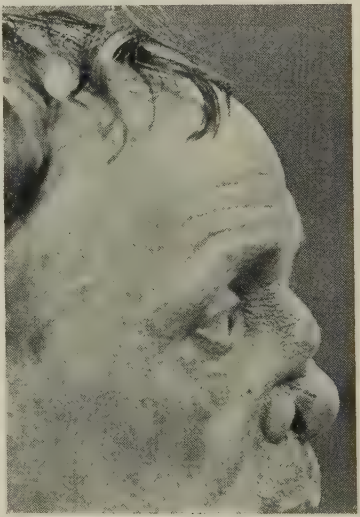

Fig. 694.

Figs. 693, 694.—Perforating gumma of the hard palate with destruction of the nose in tertiary syphilis. (Courtesy of Dr. A. Benson Cannon.)

Spinal Drainage.—This is employed chiefly for the relief of headache or vomiting in syphilitic meningitis, or as an adjuvant to intravenous treatment in debilitated subjects who have not responded to the usual methods and do not tolerate intraspinal therapy. It should be performed with the patient lying down, care being exercised not to withdraw too much fluid the first time or to withdraw it too rapidly. Ordinarily no more than 30 to 40 cc. of fluid are withdrawn. When the pressure is not extreme, the flow may stop before this amount is removed. After the drainage, the patient should lie face downward, without a pillow for an hour or two, and then should slowly rotate so as to lie upon the back, and this position should be maintained for several hours, preferably overnight. The foot of the bed should be elevated 3 or 4 inches higher than the head of the bed. These postural precautions are taken to avoid subsequent headache or other discomfort.

Spinal drainage is theoretically a better therapeutic method if it is performed when the blood stream is saturated with arsphenamine, the usual technic being to do the spinal puncture one hour after an intravenous injection of arsphenamine. The intake of fluid by mouth is limited to a minimum for twenty-four hours before and after the treatment.

Swift-Ellis Method.—This method consists of the injection of a full dose of arsphenamine or neoarsphenamine intravenously and one hour later the withdrawal of 50 cc. of blood from the median basilic vein into a sterile bottle. The blood is allowed to clot overnight in an ice chest and in the morning the serum is removed and incubated at 56 C. for one hour. A lumbar puncture is then performed and 20 cc. of spinal fluid are removed and an equal amount of the serum thus prepared is introduced into the spinal canal by gravity. Cannon has used this method in the treatment of congenital neurosyphilis which would not respond to intramuscular or intravenous therapy, taking the blood from adults one hour after an injection of arsphenamine. He has used no more than 10 cc. of the Swift-Ellis serum for the injection. He states that he has not changed the fluid serologically by such treatments, but has improved the patient's symptoms as successfully as in adult acquired syphilis.

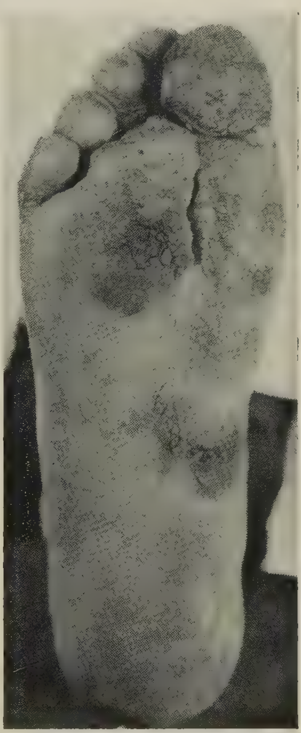

Fig. 695.—Syphilitic keratoma of the sole. This lesion is unilateral. (Courtesy of Dr. Mihran B. Parounagian.)

In the *Ogilvie method* 50 cc. of blood are withdrawn from the median basilic vein, and after it has clotted overnight the serum is pipetted into a sterile container. To it 0.1 to 0.2 mg. of arsphenamine is added. The mixture is incubated for one half hour at 56 C. and about 20 cc. are then placed in the spinal canal by lumbar puncture after withdrawal of an equal amount of spinal fluid. The Swift-Ellis and Ogilvie methods are often combined with good effects. The best results are achieved in early cases of tabes dorsalis, but there is little response in paresis, even to these measures.

A similar method for the introduction of mercury intraspinously is the *Gilpin method,* in which mercurial inunctions are pushed up to the point of saturation, while the spinal canal is regularly drained at intervals of four to five days. Another method is that of *Bryne,* which consists of the addition of 1/50 grain of bichloride of mercury to the patient's serum, the mixture being given intraspinously after incubation and after removal of an equal quantity of spinal fluid.

Malarial treatment, as has been stated, is frequently beneficial in early cases of paresis.

Symptomatic Treatment.—This is an important feature in the general management of cases of neurological syphilis. In crises and lancinating pains in tabetics various coal-tar analgesics and antirheumatics may be used, and when absolutely necessary, morphine or codeine should be given. Focal infections, especially of the teeth or bladder, should be treated and any other causes of sepsis removed. Bladder irrigations and rectal or colonic irrigations should be freely given if there is cystitis, prostatitis, or constipation. Warmth and rest of the parts affected by pain are desirable. Electric heating pads, diathermy, and the static spark may give relief. Spinal drainage and intraspinal treatment should be persistently employed and often have splendid effects.

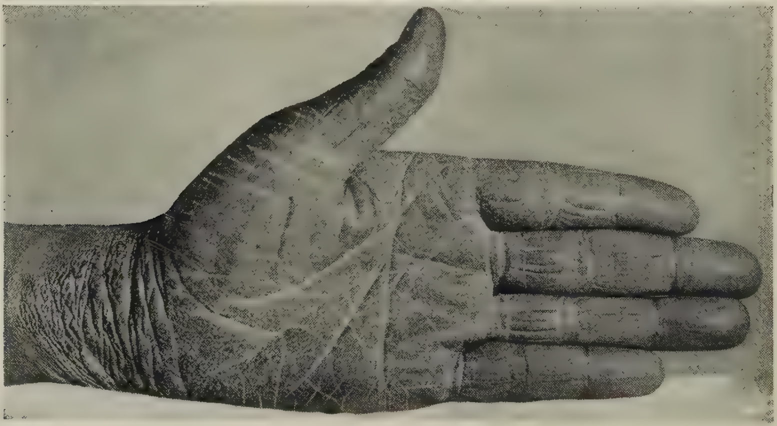

Fig. 696.—Keratotic tertiary syphilide of palm and volar surface of wrist.

Treatment of Syphilis During Pregnancy.—By proper treatment before and during pregnancy it is often possible to produce a child which is apparently free from disease. The early institution of proper antenatal treatment is so important that routine Wassermann tests should be done on all expectant mothers as part of the first examination in private practice, as well as in the clinic. The omission of a Wassermann test by the obstetrician on the grounds of friendship, expense, or for any other reason, is inexcusable. If possible the test should also be made upon the father.

In case the serology is positive, active antiluetic treatment should be instituted. Such treatment should consist principally of neoarsphenamine and bismuth, injections being given at weekly intervals without any rest period throughout the pregnancy up to the seventh month, when the danger of eclampsia or nephritis is too great to warrant its continuance. Only persistent and energetic treatment should be given to the pregnant woman and it should be begun during the first two or three months of pregnancy. If the diagnosis is not established until after the fourth month and the mother's Wassermann reaction is strongly positive, the chances of satisfactory eradication of the disease and the birth of a normal child are slight. If the prospective mother has nephritis, tuberculosis, hyperthyroidism, epilepsy, a history of eclampsia, or a sensitization to arsenic—factors which prevent the adequate use of arsphenamine—abortion may be indicated. On the whole, however, the results of antenatal treatment in uncomplicated cases are excellent and even in recently acquired syphilis offer hopes of a healthy offspring.

The method of treatment is only a little different from that employed for other women of the same age and weight and women in the same stage of the disease. The dosage of neoarsphenamine should be 0.2 or 0.3 Gm. for the first injection and should gradually be increased up to 0.5 Gm. The urine and the blood pressure should be examined before each injection, and when there are any evidences of renal irritation, the eyegrounds should also be routinely inspected. Treatment does not seem to have any deleterious action upon the mother; and the pregnancy in itself has a therapeutic effect upon her syphilis.

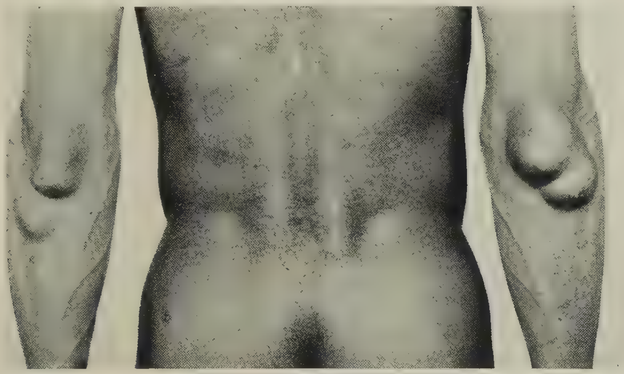

Fig. 697.—Juxta-articular nodules. (Courtesy of Dr. J. Gardner Hopkins.)

Treatment Complicated by Other Diseases.—The combination of syphilis and other diseases in the same individual is not infrequent, and at times the question arises which disease is better to treat, and whether both can be treated at the same time. To answer these questions in more than a general way is impossible, but some points which are important in outlining the treatment will be given.

The combination of *tuberculosis* and tertiary syphilis is unfortunately quite common. If the acid-fast infection is active in either the lung, larynx, or upon the tongue, treatment should be directed chiefly against tuberculosis. If any antisyphilitic treatment is given, it should not include iodides. If fever of tuberculous origin is present, the arsphenamines should not be used.

The combination of *cancer* and tertiary syphilis is most frequent in tongue lesions, and the importance of proper handling of these cases is not generally appreciated. In suspected lingual carcinoma, the presence of syphilitic smooth atrophy of the tongue or of leukoplakia or a history of syphilitic infection, or a positive Wassermann test should not in the slightest interfere with the treatment of the carcinoma. If there is doubt concerning diagnosis of the tongue lesion, a section should be removed and studied microscopically, which will make possible a confirmed diagnosis and the institution of appropriate treatment in forty-eight hours if the section is sent to an up-to-date laboratory. Most cancer of the tongue arises on a syphilitic basis, but the carcinoma is the disease of vital importance. Much valuable time will be lost by the use of antiluetic remedies and also confusion may occur by their causing a temporary and misleading decrease in the size of the growth.

In syphilitics who have *Bright's disease*, both affections may be simultaneously treated, but no mercury should be used and the doses of other remedies should be moderate, careful attention being paid to changes in renal function as evidenced by examination of the urine and the blood. The iodides, bismuth, and neoarsphenamine are the drugs usually employed.

In nonsyphilitic *cardiac disease* and *arteriosclerosis* and in essential *hyperpiesis*, the treatment of tertiary syphilis is mainly by mercury, iodides and bismuth, emphasis being placed upon the iodides and bismuth. Small doses of neoarsphenamine are sometimes given cautiously.

In *diabetes* associated with syphilis it must be determined whether the syphilis has produced the diabetic symptoms or whether they are unrelated to it. In either event, neoarsphenamine should be given in moderate doses, and then, if necessary, stronger antiluetic treatment may be given on the assumption that the syphilis is at least a contributory cause.

In *pernicious anemia* and *Banti's disease* associated with syphilis, active antiluetic treatment should be given, principal reliance being placed upon the arsphenamines.

Reactions from Drugs.—The drugs used in the treatment of syphilis to be effective must be given in intensities which are not well borne by some hypersensitive individuals. Clinical reactions of an anaphylactic nature at times increase the effectiveness of the remedy, as it is a well established fact that nonspecific protein therapy is beneficial in syphilis. Reactions, however, are sometimes serious or even fatal, and as a matter of routine should be diligently avoided.

Herxheimer Reaction.—The Herxheimer reaction or, more properly, the Jarisch-Herxheimer reaction is an irritative phenomenon which may occur in any active process, chiefly after large initial doses of arsphenamine, as well as those of mercury. During any stage of the disease, the syphilitic symptoms, both systemic and local, are suddenly exaggerated to a manifold degree. The Herxheimer reaction usually does not begin for several hours after the injection, the onset probably being simultaneous with the maximum spirocheticidal effect of the drug, and may not reach its height for several days, especially in osseous or neurological involvement. Its importance lies in the fact that a flare-up of a syphilitic inflammation in a vital structure may have serious consequences, as can be imagined when there is an aneurysm of the aorta, or iritis. When there is involvement of the nervous system, special importance is attached to the avoidance of the Herxheimer reaction. Paralyses which may result are often transitory. In the early stages of syphilis the reaction may manifest itself by an intensification of the roseola and by fever. In visceral reactions there may be a cloudy swelling of the liver, and jaundice, or even acute yellow atrophy.

Such reactions may be followed by convulsions, deafness, blindness, hemorrhage, and many other serious complications, which are sometimes fatal.

The avoidance of the Herxheimer reaction is thus exceedingly important and is accomplished by preliminary retardation of the activity of the disease before intensive therapy. It is a general rule to treat all patients at every stage by mercury or bismuth in order to diminish the intensity of local involvement before arsphenamine is given. In early primary and secondary syphilis this rule may be moderated, so that patients may receive an initial dose of arsphenamine one fourth the usual amount, without previous mercury or bismuth treatment, unless there is severe headache, vomiting or fever, in which event preliminary injections of one of these drugs are imperative.

The preliminary mercurial treatment should consist of at least two intramuscular injections of water-soluble mercurial salts on successive days, followed on the third day by a moderate dose of arsphenamine. The absorption of the mercury is rapid and it effectively reduces the activity of the local luetic involvement. Arsphenamine may then be used in ordinary dosage without the danger of producing a flare-up.

Idiosyncrasy.—An idiosyncrasy may exist to any drug and naturally some persons are peculiarly hypersensitive to the antiluetic preparations, especially the arsenicals and the iodides. Whereas personal tolerance for mercury and bismuth varies considerably, the idiosyncrasies are slight as compared with those that patients have to the arsenicals and the iodides. Idiosyncrasy should be anticipated whenever the patient gives a history of urticaria, pruritus, eczema, hay fever, and asthma. Early mild by-effects are flushing, coughing, garlic taste, nausea, or vomiting. Later reactions may produce edema, backache, headache, pruritus, urticaria, neuritis, jaundice, dermatitis, or urinary incontinence (in cerebrospinal cases). Pruritus is one of the chief indications of intolerance and is often a forerunner of dermatitis.

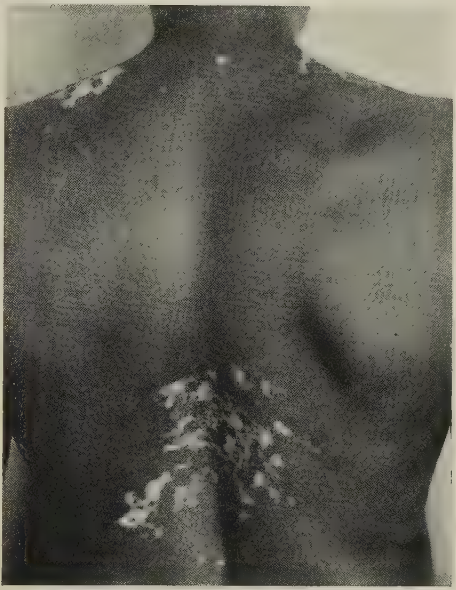

Fig. 698.—Tertiary syphilide in negress with depigmentation throughout the scar. (Courtesy of Dr. Mihran B. Parounagian.)

Nitritoid Reaction.—In some patients during the injection or immediately afterward, there occur sudden vasomotor disturbances in a train of symptoms termed the "nitritoid crisis." The reaction usually starts while the patient is still lying on the table, if the rule is observed that the patient should lie down for thirty minutes after each arsphenamine treatment. It begins by a feeling of nervousness and apprehension, rapidly followed by a flushing of the face, which becomes intensely congested, with a bluish redness that spreads downward over the neck and chest, so that the patient looks as though he were about to burst. The respiration is rapid and labored, and the pulse is fast and scarcely perceptible. Nausea gradually develops and after a few seconds or minutes vomiting occurs, which usually gives relief, accompanied by pallor, weakness, and sweating. The attack seldom lasts over fifteen minutes and the consequences are rarely serious. However, death in subjects who have unrecognized hydrothorax (or cardiovascular disease) has occurred from a nitritoid crisis.

Precautions.—The mistakes in the preparation and injection of arsphenamine which are likely to produce a nitritoid reaction are: The administration of an acid solution of arsphenamine without proper alkalinization, the use of arsphenamine which has deteriorated because of age or because of cracks in the ampules; the use of new rubber tubing which has not been thoroughly soaked in sodium hydroxide solution, and the use of imperfectly distilled water.

Serious consequences may be avoided by careful preliminary examination of the patient, by the use of fresh solutions carefully prepared from recent lots from reliable manufacturers, by slow injection of dilute solutions, and by asking the patient before each injection whether he was sick after the preceding one, when he has last eaten and whether his bowels have moved the day of the injection. In case of indisposition, cold, sore throat, fever, itching, constipation, sickness after preceding treatment or ingestion of food within three hours, the arsphenamine injection should be postponed. Following are directions for the patient before taking arsphenamine:

1. Take one and a half cascara tablets at bedtime the night before injection.
2. Do not eat any meat the night before injection, nor during the day of injection.
3. Eat only a light breakfast on the day of injection, mostly toast and coffee.
4. At noontime take a little broth, toast, tea, or coffee.
5. Do not eat anything for two hours before injection or for four hours after injection.
6. Lie down for one half-hour after injection.

As soon as there are symptoms of impending nitritoid reaction, the arsphenamine injection should be stopped, the needle being withdrawn, and a hypodermic syringe prepared with 10 to 15 minims of a 1 : 1000 solution of adrenalin, which should be injected subcutaneously if the reaction has not subsided. The adrenalin solution should always be at hand together with a sterile syringe. In severe cases 2 minims may be given intravenously. The patient should be kept recumbent and reassured; the windows should be open; cold compresses should be placed upon the head. When acid solutions or those which have been improperly neutralized have caused the reaction, the patient should receive an immediate intravenous injection of 2 Gm. of sodium thiosulphate in 5 per cent glucose solution or in water.

After there has been a nitritoid reaction, subsequent injections should be cautiously given. If the trouble is caused by an impurity in the drug or a defect in its preparation, the reaction is not likely to reappear, but if it is due to an idiosyncrasy, the tendency is apt to become progressively worse at each injection. The reaction may, however, be prevented or diminished during subsequent injections by a strict observance of the rules for personal preparation for arsphenamine injections, and by the injection of 1/50 grain of atropine sulphate or 10 minims of adrenalin chloride solution, 1 : 1000, hypodermically fifteen minutes before the intravenous use of the arsphenamine or neoarsphenamine, either of which should be very slowly injected (ten minutes). Stokes has found the divided dose method of more value, giving one tenth of the usual dose of arsphenamine or neoarsphenamine intravenously and then, after an interval of forty minutes or one hour, administering the remaining nine tenths of the total dose. He also believes that the use of alkaline buffer solutions will in time be of much practical value in preventing acute reactions, and that the divided dose technic may simply arouse the body to provide its own buffering mechanism.

Arsphenamine Eruptions.—An outstanding symptom leading to the early detection of eruptions due to arsphenamine is the common presence of itching, which precedes the appearance of most of them. At first it is often localized in the bends of the elbows or in other parts and is more or less transitory, appearing a few days after an arsphenamine injection and then disappearing before the next appointment. It is a warning of impending trouble and should always be heeded.

Urticaria due to arsphenamine may also be a warning sign of threatening arsenical exfoliative dermatitis. After the onset of urticaria the patient should receive no further arsphenamine for at least an interval of a month, and then the type of arsphenamine should be changed and given in small doses. Toxic eruptions associated with fever, chills, and headache and sometimes with vomiting may appear within a week after an arsphenamine injection. Such eruptions are usually generalized, and morbilliform or scarlatiniform, although at times more or less localized to the extremities, with a semblance to erythema multiforme. The onset of these erythematous eruptions may precede an exfoliative dermatitis, but frequently they subside without any difficulty. They are necessarily a contraindication to further arsphenamine treatment, and it is advisable that a rest interval be given for at least one month after recovery and then a different type of arsphenamine should be used. Treatment consists of sodium thiosulphate intravenously in daily doses of 1 or 2 Gm., the administration of castor oil, and of alkalinization.

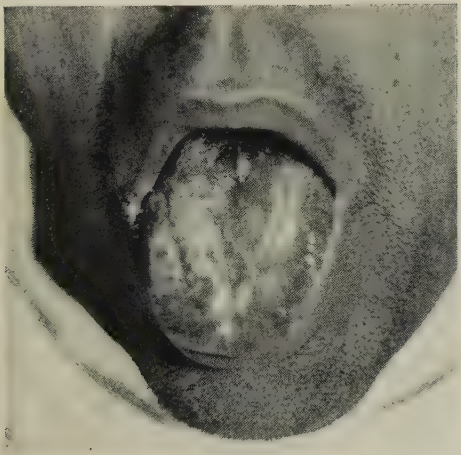

Fig. 699.—Leukoplakia and smooth atrophy of the tongue in a syphilitic.

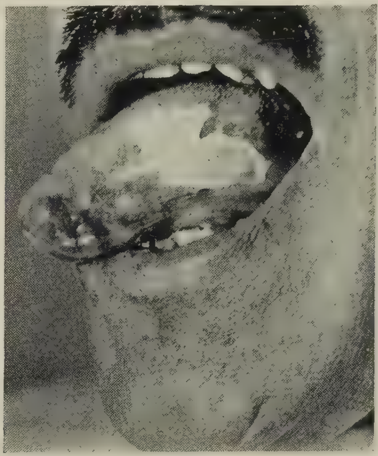

Fig. 700.—Interstitial glossitis and leukoplakia.

Arsphenamine Dermatitis.—This affection is usually a serious universal exfoliative condition of the skin which occurs after arsphenamine treatment, and is a form of hypersensitiveness. Arsphenamine dermatitis is described in the chapter on Dermatitis Medicamentosa.

Other Manifestations.—The onset of jaundice during a course of arsphenamine, or within a few weeks after the course, should be taken as a sign of toxic effects upon the liver, although the exact etiology of the jaundice is undetermined. The arsphenamine injections should be stopped and no antiluetic treatment given until the jaundice has disappeared. The disappearance is hastened by daily intravenous injections of sodium thiosulphate in doses of 1 Gm. and by the administration of this drug by mouth in doses of 2 Gm. The diet should be generous in sugars, starches, and fats, and restricted in proteins, and efforts should be made to increase elimination by drinking large amounts of alkaline waters and fruit juices. After the icterus has disappeared clinically, intramuscular injections of bismuth may be started, but no further arsphenamine should be given until one month after the blood icterus index has become normal. Observations of these precautions should adequately protect against the onset of acute yellow atrophy of the liver.

Other skin manifestations resulting from arsphenamine injections are such as result from other forms of arsenic. Pruritus, follicular keratosis, palmar and plantar hyperkeratosis, and pigmentary disturbances are the chief varieties. Such effects may begin after the injection of a few doses in persons who are susceptible to arsenic, may not appear at all or may not appear until many years after the drug has been used.

Fatal reactions to arsphenamine include those deaths which occur in arsphenamine exfoliative dermatitis, which are usually due to intercurrent disease, and deaths from collapse or shock caused by an arsphenamine injection in highly susceptible persons or in those who have organic disease, deaths from Herxheimer reactions, and those due to acute yellow atrophy of the liver.

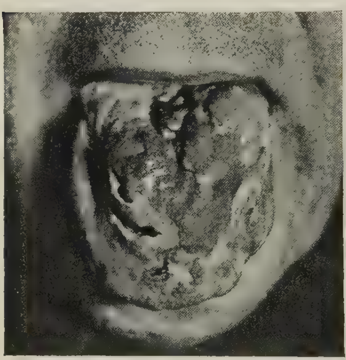

Fig. 701.—Tertiary syphilis of the tongue.

PROGNOSIS IN SYPHILIS

There is much to be learned about syphilis and, therefore, prognosis should always be conservative. The most favorable cases are those in which the patients are treated early in the course of the disease, preferably before the Wassermann test has become positive. The absence of a positive reaction in the spinal fluid is favorable. Patients in the later stages are more difficult to treat successfully and when there is cerebrospinal involvement, aneurysm, arteriosclerosis, or visceral disease, treatment should be along the lines of palliation rather than of cure.

In all cases the prognosis is materially affected by the habits of the patient and his general state of health. It is urgent to inspire in the patient an interest in personal hygiene. Regular hours for sleeping, nutritious food, sunlight, and exercise hold important places among therapeutic procedures. Those who go into training for the cure of their syphilis as they would for the winning of a race rarely fail to get good results under modern treatment. Occasionally clinical and serological disappearance of the disease is seen in those who are debilitated from excesses or poor health, but the therapeutic successes are those who have lived rigidly by the rules of hygiene.

The age of the individual at the time of infection does not affect the prognosis markedly, but the presence of tuberculosis, diabetes, nephritis, or an intolerance to arsphenamine seriously influences the outlook.

Curability.—Absolute proof of cure is impossible but clinical and serological disappearance of the disease after adequate treatment for two years or more may be a practical basis for determining a cure. In addition there must be a further free interval of two more years, during which the blood Wassermann test should be made every three months and must be completely negative, and the spinal fluid examination must be completely negative at the beginning of the free interval and when it is repeated after two years.

There is much that medical science has to learn about syphilis. The tendency to relapses has already been mentioned and these are observed sometimes after the patient has fulfilled the requirements for a cure, which have been stated.

Syphilis and Marriage.—It is the duty of the physician to warn the patient of the danger of infection and to advise against marriage until the disease has been cured, if that is possible. The patient who has received modern treatment in the early stages of the disease, who has completely fulfilled the requirements of a cure and who, during his course, has had no visceral or cerebrospinal involvement, for practical purposes may be regarded as non-infectious, but he is not as yet a suitable candidate for marriage. The period of negative tests and absence of physical signs must be five years before marriage may be safely permitted. The following cases suggest the hazards taken by syphilitics in marriage.

Case 1.—A. G. was first seen in September, 1926. Both the blood Wassermann and spinal fluid tests at that time were negative but there was a history of infection five years previously and of treatment begun early in the secondary stage when the Wassermann reaction was positive, and continued irregularly during 1923 and 1924. The Wassermann reaction became negative but was again feebly positive early in 1926 when the patient was given a course of treatment by Dr. Milian, after which the Wassermann test was negative. Dr. Milian referred the patient to me and upon her arrival in New York the Wassermann test was repeated and found negative. However, the patient received ten injections of neosalvarsan and fourteen injections of bismuth and another course of twelve injections of neosalvarsan and fourteen injections of bismuth during the period from September 15, 1926 through June, 1927. Four Wassermann tests made during this period were completely negative. Without my permission the patient was married and soon became pregnant. A course of salvarsan and bismuth was begun three weeks after the probable date of conception and was continued regularly throughout the early months, the patient receiving ten injections of neosalvarsan and twenty-four injections of bismuth. An

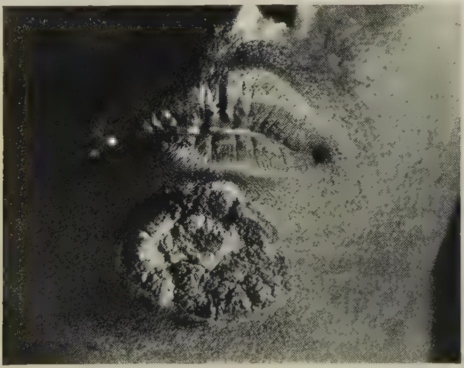

Fig. 702.—Framboesiform tertiary syphilide.

apparently healthy child was born about two weeks prematurely. The cord Wassermann test was negative and careful examination revealed no signs of syphilis. When the baby was seven days old it developed snuffles and within a week it died of bronchopneumonia. The Wassermann reaction of the mother's blood was reported plus-minus. Although syphilis was never proved in the baby, one cannot feel with certainty that there was not some relation between it and the unfortunate results of the matrimonial venture. There have been no further pregnancies although the patient has strongly desired them.

Case 2.—P. D., the son of a physician, was treated in 1922 for early secondary syphilis. He received twelve intravenous salvarsan treatments in Scranton, Pa., and mercury by mouth for three months. The Wassermann reaction, which at first was positive, became negative. The patient was free of any clinical evidences of syphilis, and after four years of negative tests he consulted two physicians, who separately advised him that it was safe to marry. He was married in 1926, and in 1927 a child was born with a bullous eruption on the soles and palms. It was three weeks premature and weighed 5 pounds. The Wassermann tests on both the baby and mother were four plus. Upon the receipt of this information, a Wassermann test on the patient was repeated and found to be four plus.

Infection with syphilis in marriage is nearly always directly traceable to previous exposure of the male with prostitutes. It is essential that the partner be informed of the situation without delay. Without this amount of frankness, happiness, which is the object of matrimony, can never be attained. Dishonesty in this respect early subjects both partners to untold suffering.

Superinfection.—Although an attack of syphilis usually confers immunity against further attacks, occasional cases are observed in which clinically a second infection has occurred. Instances of superinfection are most frequent among patients who have had syphilis for a long period and in whom the disease has become quiescent and localized in the spinal cord or brain, or in the viscera, and in those affected by congenital syphilis. The point of invasion of the second infection is usually not in the same location as that of the first infection. It has been demonstrated that resistance to superinfection is confined mostly to the originally infected tissues, and probably most of the immune bodies are produced locally by the tissues infested with the spirochetes at the site of infection.[1] Consequently second and third attacks generally follow invasions of the organism in other places—either upon another part of the genitalia or in some extragenital location. Superinfection also occurs in patients who have been insufficiently treated and, though not cured, have almost reached that point.

Reinfection.—It is often difficult to distinguish between cases of superinfection and those of reinfection, but certain cases have been demonstrated and recorded which clinically are clear illustrations of reinfection. Superinfection is the successful infection of a subject already syphilitic. Reinfection is the inoculation and production of syphilis in a subject who previously has been completely cured of the disease. The differences between the two terms depend upon the as yet undetermined curability of syphilis. The immunity conferred by the disease seems to disappear to a large measure when the disease is thoroughly cured. If the cure is complete, reinfection may occur. Parounagian showed a case which he considered one of third infection at the New York Academy of Medicine. Cases of super- and reinfection must always be distinguished from outbreaks or recurrences of the first attack of the disease. Chancre redux, monorecidive and pseudochancres may lead to confusion. All is not known regarding the clinical course of syphilis and some cases of apparent reinfection may be otherwise explained upon the basis of future serological and bacteriological studies. As it is impossible at present to prove beyond all doubt the cure of a patient treated for syphilis, it is equally impossible to prove cases of superinfection and reinfection absolutely. The consensus of modern opinion, however, entirely supports the principle of super- and re-infection as deduced from clinical observations.

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[1] Zinsser, H., Hopkins, J. G., and McBurney, M.: Studies of Treponema Pallidum and Syphilis, J. Exper. Med., 23: 329–341, March, 1916.

CONGENITAL SYPHILIS

Syphilis in the father does not necessarily imply that the offspring is infected, and much depends upon the duration of his disease prior to union. During the first four years of his infection the likelihood of the transmission of the disease to his partner is great but as time goes on the chances grow less, and if his semen is not contaminated, she may never be affected, and thus the couple may produce a child free from syphilis. The disease in the mother leads to more serious consequences, and the offspring should be considered syphilitic until proved otherwise by close physical and serological observation for a period of years. At present it seems possible that the offspring may be free from syphilis when the disease is latent in the mother, without involvement of the reproductive organs.

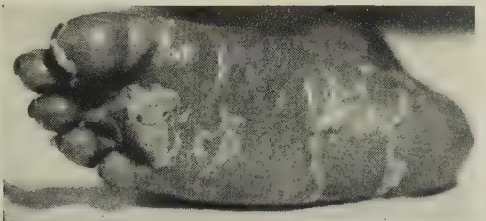

Fig. 703.—Congenital syphilis of the sole, showing desquamation.

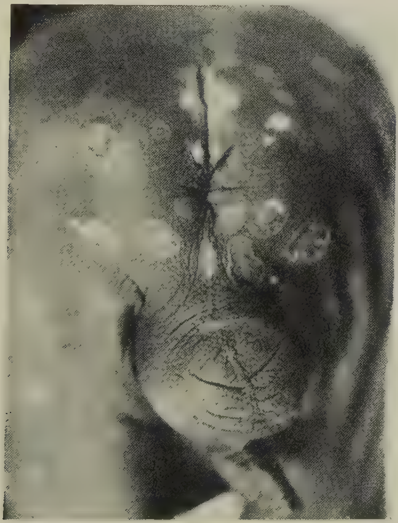

Fig. 704.—Fissures and circinate squamous syphilides grouped around anal region in congenital lues.

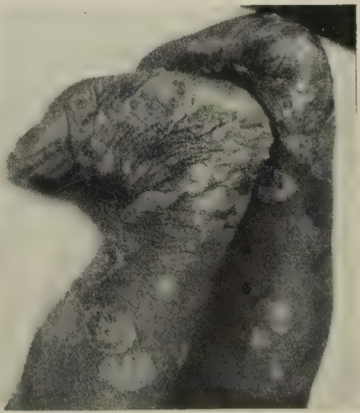

Fig. 705.—Squamous syphilide of legs and feet in congenital syphilis.

The terms "congenital syphilis" and "heredosyphilis" are used almost interchangeably for cases of the disease in which the infection is given to the offspring by the mother before or at the time of birth. The transmission is usually through the placenta, in which there are pathologic changes characteristic of syphilis. Treponemata pallida have been found in both the maternal and fetal portions of the placenta, being more common in the latter. Rarely the infection occurs at the time of labor from a recently acquired primary lesion on the mother's genitals.

Effect on Offspring.—In the fetus the results of the infection by the Treponema pallidum are similar to those observed in acquired syphilis in adults. The fetus infected *in utero* generally becomes riddled with the organisms through the fetal blood stream in a manner similar to those cases of infection of adults resulting from the transfusion of blood from syphilitic donors. Presumably no primary lesion occurs and the rampant organisms contaminate all structures, so that the fetus usually dies. The extent of the infection varies considerably, however, and sometimes an apparently healthy child is born and will show no clinical evidences of syphilis for several years. When syphilis has been present in the parents for a long time previous to conception, the offspring is affected with a comparatively mild form of the disease. In addition to the duration of the mother's infection, the amount and character of the treatment she received, the number and outcome of previous pregnancies in serial order and the nature of the lesions in the syphilitic infant assist in determining the severity of the congenital infection.

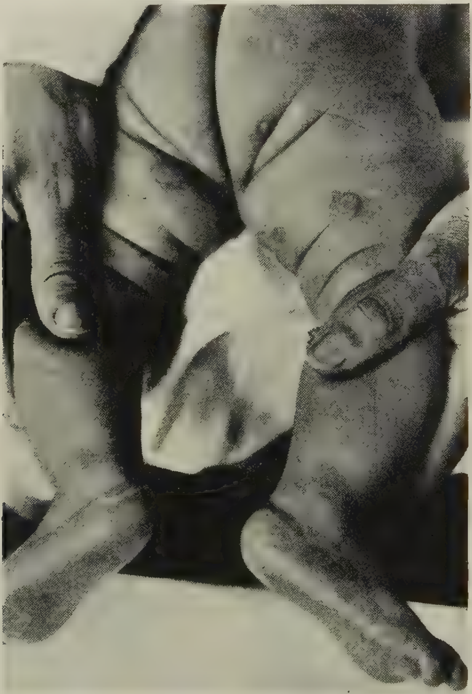

Fig. 706.—Perianal circinate syphilide.

Symptomatology.—The cutaneous manifestations as a rule are not present at the time of birth, but appear most commonly during the third week. They correspond to the lesions of the same stage of acquired syphilis, but the systemic effect is greater. The premature child is usually marasmic, fretful, dehydrated, and the face is pinched and drawn, so that it looks like that of a little old man. However, many syphilitic infants are well formed and of almost normal weight. A rhinitis, the "snuffles," is frequently one of the first specific manifestations. The cry of the child is weak and raspy. Due to the nasal discharge there may develop an eczematoid syphilitic eruption of the upper lip and about the mouth and chin, accompanied by radiating fissures from the commissures, which later leave scars (rhagades). According to the stage of the involvement, the eruption is one of the kind seen in early or late secondary or in tertiary syphilis. Mucous patches occur in the mouth and condylomata about the anus along with skin lesions of the secondary period, and there may be an associated alopecia and general adenopathy. The early eruptions are usually maculopapular and a little less widely distributed than in the acquired type in adults. More rarely the eruption is purely papular, accompanied by some scaling of the lesions. It may even rarely be purely macular; or very rarely vesicular, or somewhat pustular. The face and anogenital regions are favorite locations for these manifestations. Syphilitic pemphigus or the bullous eruption which appears on the palms and soles in congenital syphilis and which is known to most medical students as a characteristic of the disease is a relatively uncommon condition. Blebs or vesicles are present on the palms and soles and seldom affect other parts of the body, but there are frequently other types of lesions about the mouth or anus. The distribution, especially the absence of bullous lesions on parts other than the hands and feet, is a diagnostic differentiation between bullous impetigo, pemphigus neonatorum, and bullous congenital syphilis—syphilitic pemphigus. Occasionally there is a desquamation of the palmar and plantar surfaces accompanied by lesions around the mouth and in the diaper region.

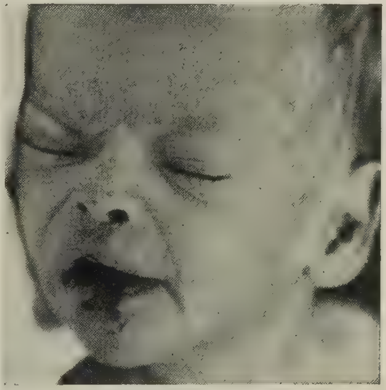

Fig. 707.—Congenital syphilis with rhagades about the mouth and nares. (Courtesy of Babies' Hospital.)

Secondary syphilis, as a rule, is easy to diagnose in infants on account of its predilection for the face, buttocks, palms, and soles. The lesions may be modified by pyogenic invaders so that they resemble impetigo. Jacquet's dermatitis and thrush infection of this region may cause some confusion. Dermatitis exfoliativa neonatorum (Ritter), a staphylococcic infection accompanied by erythema and profuse desquamation, can lead only to temporary confusion because the skin lesions are far too acute for syphilis. Infantile eruptions suspected of being syphilitic should be examined by the dark-field method, for clinical impressions should always be corroborated by the finding of the spirochetes or by a blood Wassermann test made upon the child and its parents.

In the later stage of infection the cutaneous manifestations are more or less localized to one or two regions and are of a gummatous character, being more common after the age of two years. Such lesions are of a destructive nature and sometimes are resistant to treatment. Serpiginous nodular lesions are uncommon, but otherwise the cutaneous lesions of late heredosyphilis resemble those of tertiary acquired syphilis. A rupial type of eruption consisting of a few scattered, thickly crusted lesions is occasionally observed. When the tenacious, heaped-up crusts are removed, the underlying bases are raw and bleeding.

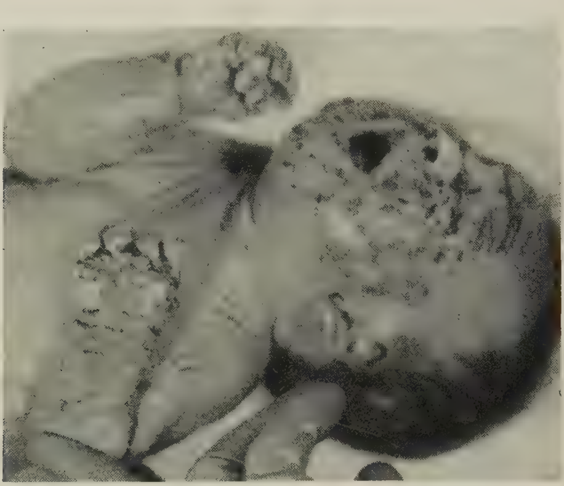

Fig. 708.—Congenital syphilis. (Courtesy of Babies' Hospital.)

The dermatological diagnosis of late heredosyphilis is assisted by the ability to recognize other abnormalities produced directly or indirectly by the Treponema pallidum. Associated with tertiary skin manifestations there is often dac-

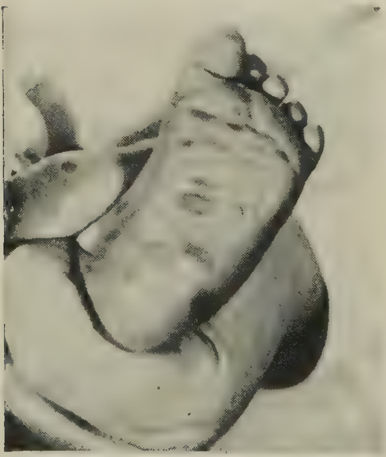

Fig. 709.—Plantar syphilide in ten-day-old baby. (Courtesy of Dr. A. Benson Cannon.)

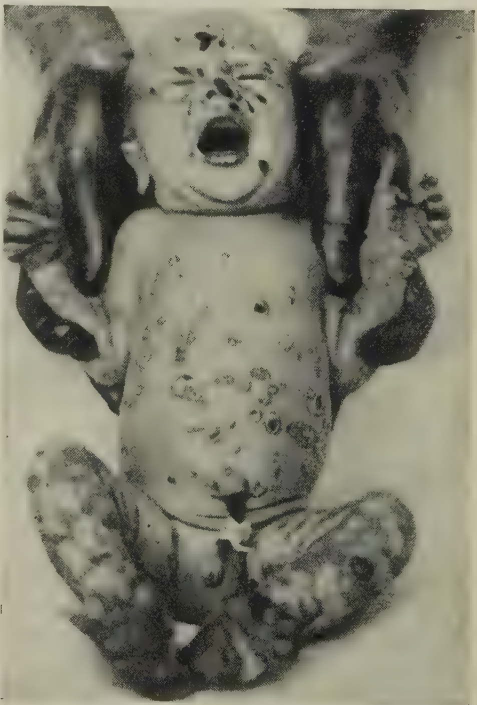

Fig. 710.—Congenital syphilis, showing pigmentation, papulosquamous lesions and ulcerations. (Courtesy of Dr. Edward A. Oliver.)

tylitis or involvement of the viscera. Epiphysitis may occur in the long bones and produce a pseudoparalysis. Eminences often develop in the frontal and parietal parts of the skull (frontal bosses), and there may be a distinctive contour to the skull, which is cubic or "box shaped." A deformity of the tibia characterized by anterior bending and a fusiform enlargement of the middle third is known as the saber tibia. Interference with the development of the nasal process of the malar bone leads to the characteristic "saddle-nose." The nose is stubby, with large nostrils, a depressed bridge, and a broad base, so that the eyes appear to be widely separated. Several deformities of the teeth deserve mention, some being more distinctive than others. The well known Hutchinson's teeth are an involvement of the upper central incisors of the second or permanent set causing their growth to be stunted, producing in addition a peg-shape, which is narrower at the cutting edge than at the neck, and one which is notched on the biting surface. The general shape of the tooth and the crescentic notch on the cutting edge are the important features, and the dentin may be otherwise pitted. Mulberry molar is a

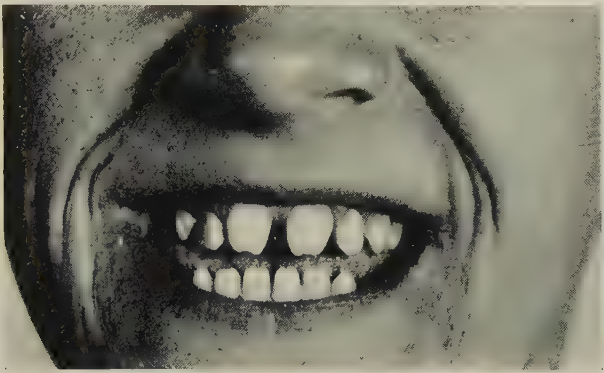

Fig. 711.—Hutchinson's teeth.

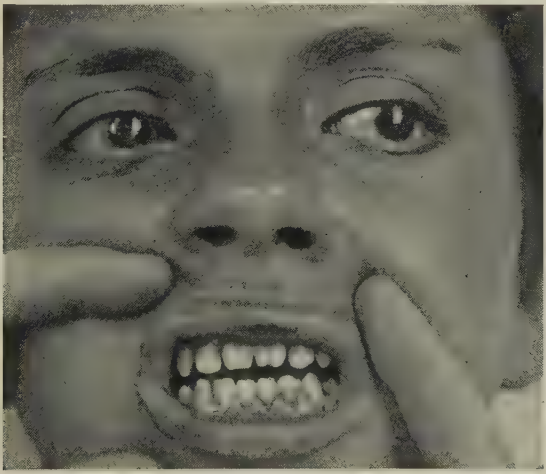

Fig. 712.—Hutchinson's teeth. Interstitial keratitis. (Courtesy of Dr. Mihran B. Parounagian.)

term used for changes in the sixth year upper and lower molars, which present lateral projections in the form of shoulders from the cusps, which are small and fragile. An accessory cusp on the inner side of the upper first molar is a disputed diagnostic sign called the tubercle of Carabelli. In rare cases the nails are affected and usually they are foreshortened and rounded, so they look like small clam shells. The anterior hair line of the scalp may be high and irregular, and there may be a high palate arch, or asymmetry of the face. Similar malformations may be produced by diseases other than syphilis. Mental deficiency, deafness, paralyses, and epileptiform convulsions in young persons are often of syphilitic origin. "Hutchinson's triad" includes the Hutchinsonian teeth, interstitial keratitis, and deafness. Interstitial keratitis is rare before the age of five, but between the ages of five and fifteen years it is the most common complaint. It is characterized by a circumcorneal congestion and a grayish cloudiness of the cornea, which begins in small patches, but spreads until the entire cornea resembles ground glass. The blood Wassermann reaction is, with few exceptions, strongly positive in interstitial keratitis, and the spinal fluid is regularly negative. Choroiditis, retinitis, and iritis are frequently present. The visceral changes may be manifested by enlargement of the liver, spleen, or testicles, or by affections of the cardiovascular system. Stokes has tabulated the direct results of infection and the indirect disturbances of growth as follows:

The Landmarks of Late Heredosyphilis

Major.[1]	Secondary.[2]	Minor.	Debatable.
Positive blood Wassermann. Interstitial keratitis. Hutchinsonian incisors. Mulberry molars. Eighth nerve deafness. Saber tibiae: Osteitis. Periostitis. Simple hypertrophy. Osteitis of the nasal septum: Snuffles. Saddle bridge. Epiphysitis and osteochondritis. Splenomegaly before the fourth month. Rhagades and scars. Early dactylitis. Facies.	Frontal bosses. Aplasia of incisor teeth. Scaphoid scapula. Disturbance of age development ratio. Precocity and high nervous irritability. Early epitrochlear adenopathy. High narrow palatine arch.	Venous ectasia. Hypertrichosis. Ulnar deviation of middle fingers. Constitutional subnormality. Backwardness. Hypertrophic frontal suture. Craniotabes. Bilateral dacryocystitis in childhood.	Carabelli tubercle. Retromastoid adenitis. Persistent infantile hydrocele. Hypertrophic thymus and thymic abscess. Alopecia areata in children. Knock-knee elbow. Urticaria and asthma in young children.

[1] Strongly presumptive or diagnostic.
[2] Insufficient for diagnosis alone.

Cannon, in a study of 202 cases of congenital syphilis, has established the frequency of the various manifestations, the most common finding being interstitial keratitis; his observation agrees with that of Hazen and Stokes. He reported that 52 per cent out of 202 cases applied for medical attention because of interstitial keratitis. "Arthritis was the second most frequent cause, being present in 15 cases. Gummatous ulcers were noted in 14; retarded mentality in 10, and various other complaints such as periostitis in 3, deafness in 3, hydrocephalus in 3, pseudoparalysis in 2, and 1 each of optic atrophy, stomach trouble, alopecia areata, spinal curvature, dwarfism, and chronic sinusitis."

Complete physical examination showed that the most usual defects were dental deformities; 64 patients had wedge-shaped anterior incisors; 45 presented tubercles of Carabelli; 33 had mulberry molars; 25 delayed dentition, and 21 Hutchinson's teeth. Next in order of frequency were a high palate arch, which was found in 74 cases; thin, irregular hair in 41 cases; asymmetry of the face with prominent bosses of the head in 25; changes in the pupillary and deep reflexes in 19; saber shins in 15; deafness in 8; malocclusion of the teeth in 5; saddle-nose in 4, and hydrocephalus in 4. These observations correspond approximately with those of Jeans.

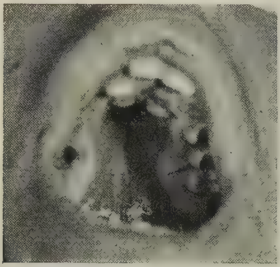

Fig. 713.—Congenital syphilis with narrow high palatal arch and marked irregularity of dentition.

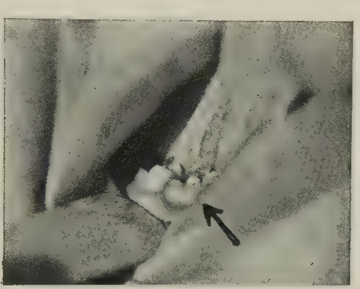

Fig. 714.—The "mulberry" or six-year molar in heredosyphilis. Note the dwarf cusps of the anterior tooth and the hypertrophied enamel ridge which surrounds them. (Courtesy of Dr. John H. Stokes.)

"An examination of the spinal fluid showed it to be negative in 152 cases and positive in 16, that is, positive in $10\frac{1}{2}$ per cent." Ninety-one of Cannon's patients were normal mentally.

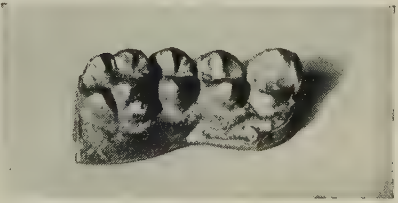

Fig. 715.—Tubercle of Carabelli on molar tooth. (Courtesy of Dr. Mihran B. Parounagian.)

Diagnosis.—The diagnosis of congenital syphilis is made by laboratory examinations, which have already been described in acquired syphilis. The dark-field demonstration of the Treponema pallidum is a rapid means of diagnosis when the lesions are favorable for examination. The most likely lesions are moist papules or syphilitic bullae. The Wassermann reaction is not as dependable in congenital syphilis as in the acquired form, especially during the first few months, after which time it is generally strongly positive in syphilitic infants. In suspected cases it is advisable to repeat the test every three months for the first few years and later to do annual examinations. Cannon states: "In the absence of positive serologic data it is frequently difficult to make a diagnosis of congenital syphilis. However, I believe that the Hutchinson's triad (interstitial keratitis, deafness, and notched, wedge-shaped anterior upper incisors) is pathognomonic of congenital syphilis. I have never seen Hutchinson's teeth in other than persons with congenital syphilis or in the offspring of syphilitic parents, and I believe that syphilitic interstitial keratitis is so rarely seen in acquired syphilis that it can be considered evidence of congenital syphilis. I have observed Carabelli tubercles more often in nonsyphilitic individuals than I have in those with congenital syphilis. The same observation has been made by Locapere and Laurent, and by Stokes. The high palate arch, scaphoid scapula, saber shins, irregular hair line, and asymmetry of face may also be found in other than syphilitic children."

Wassermann tests of the blood of both parents should be made in case they have been omitted during pregnancy and there are signs which lead to a suspicion of syphilis in the offspring whose blood Wassermann reaction is negative. The cord blood Wassermann examination utilizes blood obtained from the umbilical cord at birth. The chief objection to this procedure is the unreliability of the test at this time. A positive result should always be confirmed by the subsequent examination of the blood of the child, as well as of its parents.

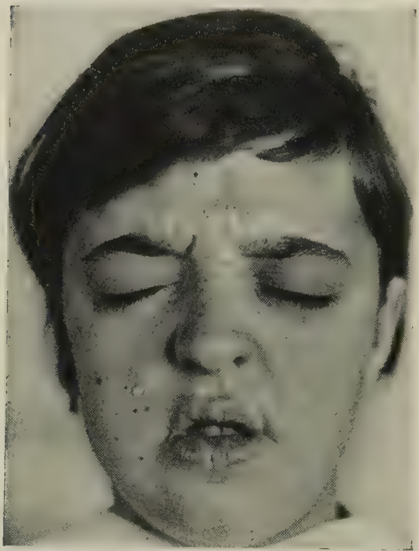

Fig. 716.—Prominent frontal bosses and rhagades at corners of mouth.

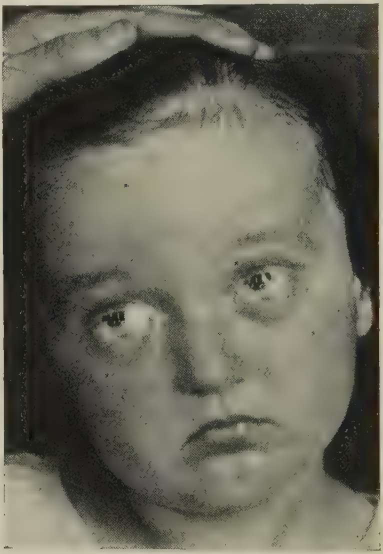

Fig. 717.—Imperfect hair line, interstitial keratitis and rhagades. (Courtesy of Dr. Mihran B. Parounagian.)

Treatment.—The modern treatment of congenital syphilis is chiefly by injections intravenously or intramuscularly along the lines of adult acquired syphilis. The drugs employed are neoarsphenamine or sulpharsphenamine, mercury bichloride, or salicylate, soluble or insoluble salts of bismuth, and the iodides. Mercurial inunctions are beneficial but it is often difficult to have them done regularly and accurately because of poor cooperation on the part of the parents. In private practice the method works best, for the parents are usually more intelligent and cooperative than those met in the clinics. It is impossible to cover the choice of drugs and dosage more than in a general way, as they are influenced by the physician's technical skill, as well as by the intensity and stage of the infection, and the part involved.

Intravenous injections are readily made in infants by those who have had extensive experience. Usually the veins at the elbow are located by palpation without much difficulty, and they can be entered by a hypodermic needle attached to a 2 cc. syringe. When this route is impossible, the external jugular vein may be used. The child is placed upon its back on a table, with its head hanging over the edge and rotated to one side by an assistant. The feet and hands are securely held by another. As the child struggles and cries the jugular vein becomes distended and can be clearly seen and palpated, extending from the angle of the jaw to the juncture of the outer and middle thirds of the clavicle. The skin is painted with tincture of iodine, which is removed by alcohol. The syringe containing the neoarsphenamine solution, with a 20-gauge needle, 1¼ inches long, attached, is held in the hollow of the hand, as one holds a quoit, and is lowered parallel to the surface of the neck, the needle being directly over the vein. With the syringe lying quite flat on the side of the neck, the point of the needle is with one short quick motion plunged through the skin and upper wall of the vein into its lumen. The appearance

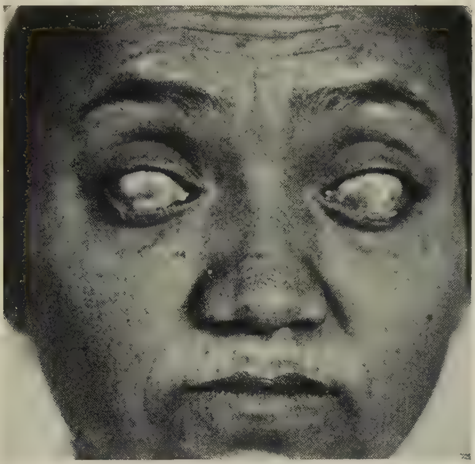

Fig. 718.—Old interstitial keratitis with blindness.

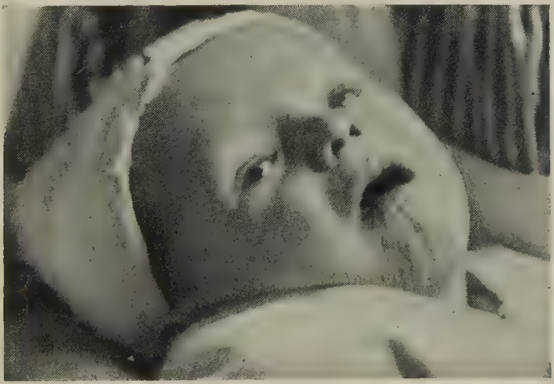

Fig. 719.—Rhagades in congenital syphilitic infant. (Courtesy of Dr. Nathan T. Beers.)

of a flare of blood in the syringe signifies that the needle is within the vein. The solution is slowly injected, care being taken to avoid air bubbles; then the needle is withdrawn with one deft quick motion, and the child immediately placed in a sitting position with a piece of cotton saturated with alcohol or with a piece of sterile gauze pressed firmly over the site of injection. The pressure is maintained for several minutes to avoid a hematoma. Sulpharsphenamine may be given by the same technic.

Both sulpharsphenamine and neoarsphenamine may be given intramuscularly by injection into the buttocks, but for those who are not expert technicians, the former is the preferable drug for this route. Needles used for intramuscular injections in infants should be 20 gauge, ½ to 1 inch in length. The dose is divided between the two buttocks, half of it being given in each side. The punctures are made in each upper outer quadrant in a similar manner to the intramuscular treatment of adults. The needle should be inserted up to the hilt, so that the deposit is placed deep in the muscle. Pain caused by the injection is principally due to the needle puncture. The chief objection to this form of administration is the danger of abscess formation, which is usually due to a chemical necrosis rather than to infection. The only way to prevent such abscesses is to avoid injections so long as there is any lumpiness on account of unabsorbed previous deposits. Repeated injections in the same site at frequent intervals naturally create a local fibrosis and a reservoir of unabsorbed remnants, both of which increase the likelihood of abscess formation.

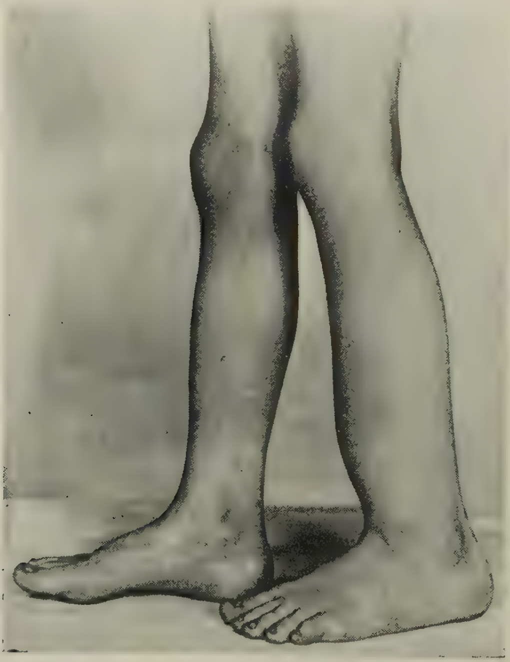

Fig. 720.—Deformity of tibia giving the so-called "saber shin."

The abscesses start as deep, tender nodules, which gradually become larger and more painful until drainage is established. In the early stages the abscess may often be aborted by poulticing, but later when there is fluctuation, it must be incised or allowed to rupture spontaneously. The pain is generally sufficient to interfere with the feeding, and for this reason incision at an early date is usually best.

Fordyce and Rosen describe treatment by intramuscular injection of neoarsphenamine and bichloride of mercury, the latter being dispensed in palmitin in collapsible ampules containing $\frac{1}{10}$ to $\frac{1}{8}$ grain, or more for older children. "The object in giving a soluble mercury in oil is to favor slow absorption of the drug. In this form it requires about three or four days for absorption. The palmitin, which is in colloidal state, is semisolid at room temperature and liquefies at 110 F. When ready for use, the syringe being still warm after its removal from the sterilizer, the contents of the ampule are expressed into the barrel, all the air removed, and if the oil has not liquefied from its contact with the hot syringe, the latter with the drug may be immersed in hot water for a minute.

"An ordinary mercury needle of 19 or 20 gauge, cut down to from $\frac{1}{2}$ to 1 inch in length, is used. After the buttock has been sterilized with iodine, the injection is given into the muscle about 1 inch from the intergluteal fold near its upper angle. . . .

". . . As compared with aqueous solutions of mercuric chloride larger doses can be employed with an oily menstruum, absorption is less rapid, and the attendant pain of the injection not so great. The slower absorption permits longer intervals between injections. For the present we are giving from six to eight treatments at weekly intervals, followed by a rest period of from four to six weeks.

"If the infant is very much under weight with a poor musculature, mercury alone is given at weekly or biweekly intervals until there is an improvement in the general condition, after which the injections of neoarsphenamine are begun."

The neoarsphenamine is in ampules containing from 0.1 to 0.2 Gm. and large enough to hold 5 cc. of solution, the object being to dissolve the drug in the original container. "After the ampule has been immersed in alcohol to insure its proper sealing and sterilization it is dried with sterile gauze, the end broken off, and from 2.5 to 3 cc. of cool sterile, freshly distilled water injected into it by means of a syringe. We then attach to the latter a Luer mercury needle long enough to reach to the bottom of the ampule and draw the fluid into the barrel, alternately expelling and drawing it up to hasten complete solution.

"The complications following the intramuscular injection of neoarsphenamine, such as abscesses and infiltrations, can be avoided if the drug is injected deep into the muscle. To prevent its leaking into the subcutaneous and adipose tissue, we have devised a special needle from $\frac{1}{2}$ to 1 inch in length (somewhat longer for older children), of 19 or 20 gauge, with an oval concave shoulder which fits snugly over the buttock, the shank of the needle being inserted flush with the under surface of the concavity. This enables one to hold the needle in place, no matter how much the child moves. With the ordinary needle the slightest motion of the child changes its position, and unless the operator watches this carefully he injects the drugs into the subcutaneous and adipose tissue with unpleasant by-effects. After the injection, the needle is rapidly withdrawn and a cotton pledget held firmly over the site for a few minutes. The site of injection is the same as for the mercurial treatment; half of the solution is injected into each buttock previously cleansed with tincture of iodine."

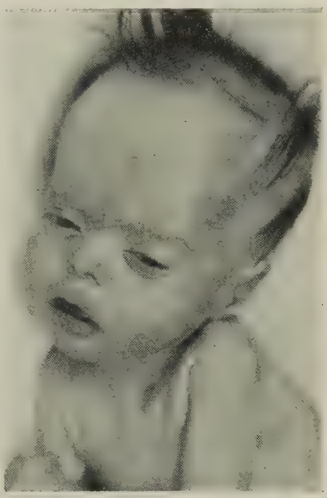

Fig. 721.—Congenital syphilis with marked prominence of frontal and left parietal bosses. Lips are involved in a dry fissured process. (Courtesy of Babies' Hospital.)

The intravenous dosage recommended by Kolmer is as follows:

Age.	Neoarsphenamine and sulpharsphenamine, Gm.	Arsphenamine, Gm.
Birth to 3 weeks	0.04	0.02
4 to 8 weeks	0.06	0.03
2 to 6 months	0.10	0.05
6 to 12 months	0.15	0.10
1 to 2 years	0.20	0.15
3 to 5 years	0.30	0.20
5 to 12 years	0.40	0.30

Cannon uses neoarsphenamine intravenously whenever possible but otherwise intramuscularly in the following dosage: in infants up to one year of age, from 0.1 to 0.25 Gm.; from one to five years, 0.15 to 0.3 Gm.; and from five to ten years old, 0.2 to 0.5 Gm. "The first four injections are given twice a week, after which the intervals are lengthened to seven days. Each course consists of ten injections of neoarsphenamine and fifteen of mercuric chloride, the latter drug being continued after the termination of the arsphenamine injections until the total number has been given. The injection of arsphenamine is then continued, this time without the mercury, which is resumed only after the completion of the course of arsphenamine.

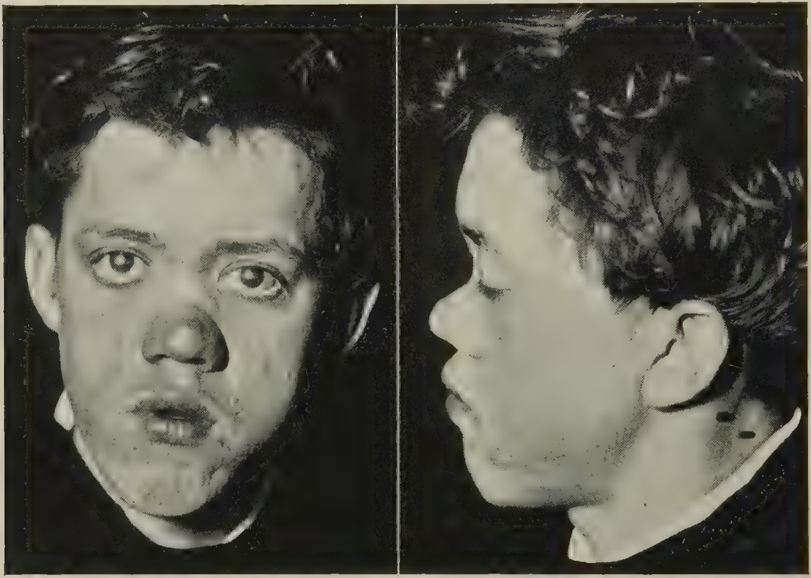

Fig. 722. Fig. 723.

Figs. 722, 723.—Two views of saddle-nose in congenital syphilis. Interstitial keratitis and prominent rhagades radiating from mouth are also shown. (Courtesy of Dr. Edward A. Oliver.)

"Potassium iodide is given at intervals during the mercury injections. This plan of treatment is continued for three or four courses of arsphenamine and mercury or for from one to one and a half years. When an interruption of the injections is necessary, barring physical ailment, the patient is put on mixed treatment. Monthly routine urine analyses and occasional blood counts are made."

Kolmer recommends the following dosages of mercurials and iodides in the treatment of congenital syphilis:

(*a*) By *inunction:*
    30 to 50 per cent mercurial ointment: 15 grains twice weekly.
    85 per cent calomel ointment: 15 grains twice weekly.
(*b*) By *intramuscular injection* (bichloride, succinimide or salicylate in oil; mercurosal or bichloride in water) once a week:
    3 to 8 weeks: 1/20 grain (0.003 Gm.).
    2 to 6 months: 1/10 grain (0.006 Gm.).
    6 to 12 months: $\frac{1}{8}$ grain (0.0075 Gm.).
    1 to 3 years: $\frac{1}{6}$ grain (0.01 Gm.).
    3 to 5 years: $\frac{1}{4}$ grain (0.015 Gm.).
    5 to 12 years: $\frac{1}{3}$ grain (0.02 Gm.).

(c) By *ingestion* three times daily:
  (1) Mercury with chalk: $\frac{1}{8}$ to $\frac{1}{2}$ grain. Dover's powder may be added: 1/20 to 1/12 grain.
  (2) Bichloride of mercury: 1/200 to 1/60 grain.
  (3) Calomel: 1/40 to 1/10 grain.
  (4) Potassium iodide: 1 to 5 grains.

Bismuth is now generally accepted as an antisyphilitic remedy of unquestionable merit. It has been used in congenital syphilis with benefits which parallel those in the acquired form. Although inferior to the arsphenamines as a spirocheticide, it causes almost as rapid disappearance of syphilitic manifestations, and because of its nontoxicity it is superior to mercury. Wright uses bismuth "as the main adjunct to the arsphenamines, confining the use of the latter to one or two courses of eight injections, and then depending upon the bismuth to complete the arrest of the disease." He states that bismuth has a "particularly favorable action in the treatment of interstitial keratitis, its therapeutic effects rivaling if not surpassing those of the arsphenamines."

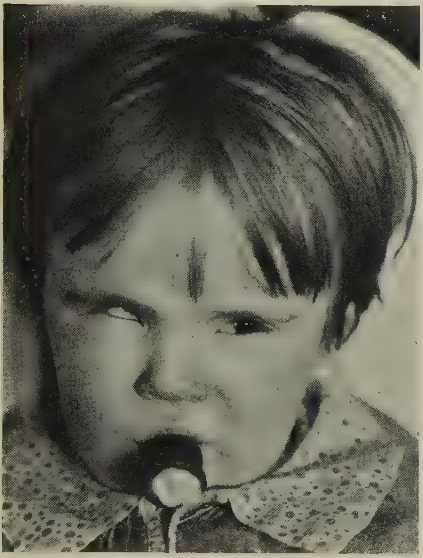

Fig. 724.—Ocular paralysis in congenital syphilis.

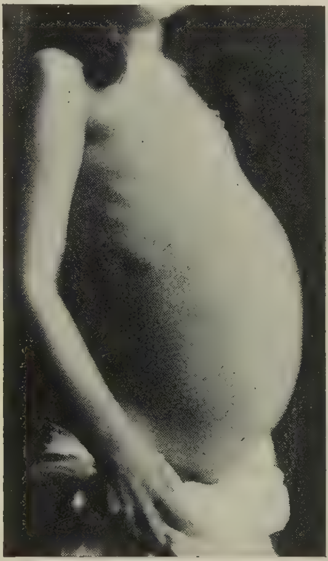

Fig. 725.—Enlargement of the liver in congenital syphilis. (Courtesy of Dr. Nathan T. Beers.)

The dosage of bismuth is governed by the body weight, being tolerated in a larger dose per kilogram in infants than in adults. Wright recommends a dose of 5 mg. per kilogram, although in older children the total dose should not exceed 100 mg., which he found kept the body saturated as evidenced by a blue line along the gum margin. The technic for the intramuscular injection of bismuth in children follows that already described for antisyphilitic drugs. Injections are given at weekly intervals for three or four months and then discontinued for a month or two and then resumed. Renal irritation has been noted by Frank.

Children of Syphilitics.—The offspring of those who have syphilis are infected from the maternal blood through the placenta if the disease is transmitted. Children born of untreated syphilitics during the first few years of the course of the disease are almost invariably infected, but after it has run a longer period the chances of its transmission to the progeny are diminished, so that, as stated, it is not uncommon for healthy children to be born of unions in which the mother is healthy, and the father has neurosyphilis. In late cases, even though the subjects were insufficiently treated, unless the disease has localized itself in the reproductive organs, its transmission to offspring is unlikely.

The married woman who has syphilis frequently relates the following type of history as regards pregnancies:

First pregnancy—a miscarriage at five months.
Second pregnancy—a stillbirth.
Third pregnancy—a stillbirth.
Fourth pregnancy—premature; child lives a few days, dies of marasmus.
Fifth pregnancy—child born full term, dies in infancy.
Sixth pregnancy—full-term child, has snuffles, lives, has positive blood Wassermann reaction.

When children are born with syphilis or develop signs of it soon after birth, the prospects of eradication of the disease differ somewhat from those in the case of adults who have acquired it, because in the congenital patients that live the disease is, so to speak, "bred in the bone" and there is a certain symbiosis between the human cells and the spirochetes which makes it unusually difficult to eradicate the latter completely. The impression that congenital syphilis is a hopeless disease from the standpoint of treatment is, however, erroneous.

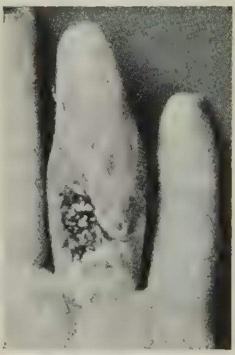

Fig. 726.

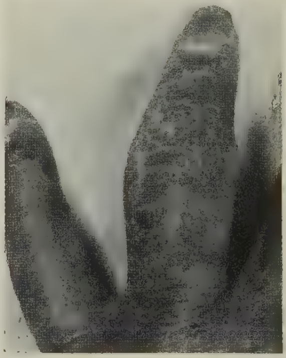

Fig. 727.

Figs. 726, 727.—Anterior and posterior views of ulcerated dactylitis in congenital syphilis. (Courtesy of Dr. Mihran B. Parounagian.)

The prognosis depends largely upon the stage and extent of the involvement and the adequacy of the treatment. There is a bad prognosis in congenital syphilitic nephritis and meningitis, but, on the other hand, in uncomplicated early cases it is often favorable, especially if antenatal treatment was given. If therapeutic methods are instituted soon after birth and are persisted in, the results are also good, barring those cases in which the patients are in a very bad condition before treatment is begun. The prognosis in congenital cases during an early stage is more favorable than it is during the more advanced stage. However, congenital syphilis due to late syphilis in the parents is generally a much milder infection with a much better prognosis than when due to early syphilis in the parents.

Whereas the five-year marriage rule applies to the average adult male patient, it should not serve in the case of females, because they can transmit syphilis to their offspring for any number of years after acquiring the disease; but the hazards gradually decrease according to the duration of the disease.

As pointed out by Stokes, the transmission to the marital partner is not the only issue in the weighing of fitness to marry. "The acquiring of a syphilitic infection, especially by the male, induces automatically a certain inescapable risk of future breakdown. At least 5 to 10 per cent of syphilitic husbands will develop neurosyphilis and an unknown proportion will develop cardiovascular lesions in spite of vigorous modern treatment. The families of such patients may become a cost to the community, to say nothing of the social loss entailed by the removal of parental influence. The younger the patient with syphilis who seeks marriage and the less prepared economically to meet the risk of complications, the more cautious should the physician be in sanctioning the establishment of a family."

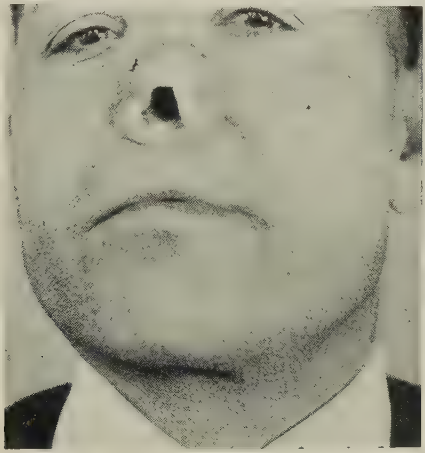

Fig. 728.—Congenital syphilis. Destruction of the nasal septum. (Courtesy of Dr. J. Gardner Hopkins.)

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CHAPTER XXVI

DISEASES DUE TO ANIMAL PARASITES

SCABIES

Synonym.—Itch.

Scabies is an infectious disease of the skin produced by *Acarus scabiei* and characterized by itchy papular lesions which involve chiefly the interdigits of the hands, the flexures of the arms, the axillae, the nipples, the lower abdomen, the genitals, and buttocks.

The *Acarus* (or *Sarcoptes*) *scabiei* lives upon the skin, which is penetrated only by the female parasite, which burrows into the stratum corneum and there deposits her eggs. The burrows form macroscopical lesions which are clinically characteristic, being slightly elevated grayish, straight, tortuous, or dotted lines in the skin. At the point of penetration a vesicle or pustule is produced. The parasite has an ovoid, flat yellowish-white body and has four pairs of legs, some provided with suckers and some with bristles. The female parasite when impregnated is 0.3 to 0.4 mm. in length, being barely visible, whereas the male is about half that size. The male dies after copulation and the females after the ova are laid. In four to eight days larvae are hatched out.

Although the pathognomonic lesion of scabies is the burrow, it is frequently not discovered even on close inspection with a magnifying glass. Its most common location is on the webs between the fingers. In infants and children the burrows are usually well marked and accompanied by vesicles, symptoms also encountered in adults who have delicate skins. In adults with tough skins the burrows are likely to be small and the hands little affected. The disease spreads from the fingers to the flexures of the wrists and forearms, to the axillae, abdomen, and genitals in the form of an itchy papular and vesicular eruption. In infants, in addition to these regions, the face, scalp, and soles are usually involved, although these areas are free in adults. The eruption varies considerably in different cases, according to the manner of infection, the degree of personal cleanliness, the duration, and the treatment which has been applied. In those who have contracted scabies in sleeping cars and from dirty hotel linen, the lesions tend to be principally upon the trunk, especially the lower abdomen and the genitals; the hands and arms in many cases being free in contradistinction to those cases in which the infection is manual. In those who bathe carefully twice a day the eruption is seldom pronounced and usually the clinical diagnosis must be made from the distribution of the itching and a few papular lesions. On the other hand, in those who are not cleanly, the usual eruption may become predominantly furuncular. When the disease has been present a long time, there is also liable to be furunculosis, as well as eczematization and lichenification. In children, impetigo, paronychia, furunculosis, and pyodermia are frequently present secondarily; there is often an associated pediculosis corporis, or capitis. As stated, not infrequently the appearance of the eruption of scabies is modified by treatment which has been given for it, the most common complication being sulphur dermatitis, in which the skin is dry, erythematous, pruritic, swollen, and scaly, especially on the face. Dermatitis is often produced in the treatment of scabies by the injudicious use of mercury, balsam of Peru, tar, and sometimes by the application of ultraviolet light.

Animal Scabies.—Various acari affect animals with which man comes in close contact and frequently an infection resembling scabies occurs in humans, being derived from pets, especially dogs, cats, poultry, and horses. The animal parasites do not find the human skin a favorable habitat, wherefore human cases contracted from such sources generally run a mild course.

Norwegian Scabies.—This is a severe type of scabies accompanied by profuse crusting and pustulation, which is encountered among lepers, among those suffering from wasting diseases, and others living under unsanitary conditions. Lesions are present on the face and scalp as well as other parts, and there may be eosinophilia and albuminuria.

Diagnosis.—The diagnosis of scabies is usually based upon the presence of an itching eruption which does not affect the face or scalp in adults, with burrows on the webs of the fingers, and papular and vesicular lesions on the flexure aspects of the forearms, the anterior axillary folds, the nipples, the lower abdomen, the genitals, and buttocks. In women, itching of the nipples associated with a generalized pruritic, somewhat papular eruption is characteristic of scabies, whereas in men itching papules on the penis and scrotum in association with generalized itching are equally typical. When other members of the family have itching and when it is worse at night, a suspicion of scabies is aroused. In adults, too much stress cannot be laid upon the freedom of the face from involvement. The common skin diseases, in addition to scabies, which affect the trunk but not the face, are pityriasis rosea, tinea versicolor, pediculosis corporis, and lichen planus, all of which can usually be distinguished from scabies without much difficulty. In pediculosis corporis the chief part attacked is the interscapular region where there are parallel scratch marks. There are no lesions in the interdigits or on the wrists, and

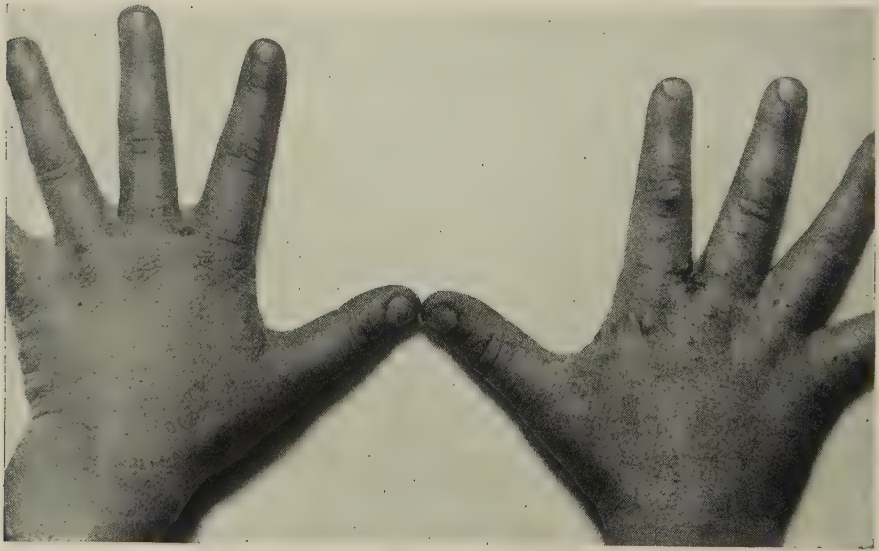

Fig. 729.—Scabies. Note the burrows between the right index and middle fingers, and the excoriated papules. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

no burrows. When there is doubt about the presence of scabies, familiarity with the modifications which can be produced in its appearance by secondary infection and the irritation by medicaments is of value. Positive diagnosis is made only by the demonstration of the acarus under the microscope, the low power objective being used. The acarus is most easily demonstrated in recently formed burrows, from which it is obtained by scraping with a Hagedorn needle. As stated, it appears as a grayish speck to the naked eye. The parasite should be transferred to a glass slide, immersed in a drop of glycerin, and pressed down with a cover glass; or the burrow may be shaved off with a safety razor blade and placed in a drop of 15 per cent solution of sodium hydroxide on a slide and then examined. The acarus may also be obtained from fresh papules and vesicles, and is lodged rather deep in such lesions.

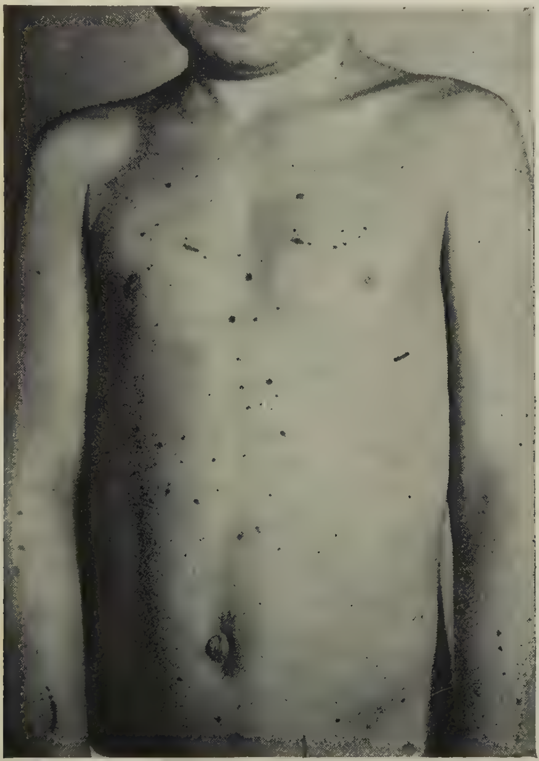

Fig. 730.—Characteristic excoriated papular eruption of scabies in a child.

Treatment.—Treatment is entirely external. The underwear, night clothes and bed sheets should be changed daily for four days, to avoid reinfection. Other persons in close contact with the patient should be inspected, and treated if affected.

Sulphur ointment is the most reliable remedy, destroying the parasites and relieving the pruritus. Beta-naphthol, balsam of Peru, oil of cade or phenol may be added to it. The exact composition of the ointment and the method of its use are important. The strength of sulphur prescribed depends upon the presumed toleration of the patient's skin. In infants and small children 1 to 3 per cent of precipitated sulphur is used; in older children, in women who have delicate fair skins and in those whose skins are irritated by preceding injudicious local applications which did not contain sulphur, 5 to 8 per cent precipitated sulphur may be used; whereas for adults with coarse dark skins or for those who have been unresponsive to milder treatment, the strength should be 10 to 15 per cent precipitated sulphur. The best base for the ointment is lanolin, to which, in cold weather, small amounts of petrolatum album may be added. Beta-naphthol has an antiparasitic and antipruritic action but has a disagreeable odor and is poorly tolerated by some skins. For this reason its utility is limited largely to the treatment of male adults, when it is added in ½ to 3 per cent strength to the sulphur ointment. Phenol, ½ to 1 per cent, may be added to the sulphur ointment for the first two or three days if the itching is severe. Balsam of Peru has its chief value in conjunction with sulphur ointment in strength ranging from 3 to 10 per cent, in the treatment of recalcitrant cases, or alone in the form of an ointment for patients who are intolerant to sulphur. It may be absorbed and cause nephritis if used too freely. When the skin is eczematized or lichenified the stimulating effects of balsam of Peru or oil of cade, 1 to 5 per cent, added to sulphur are beneficial. Wilkinson's formula, given below, is popular:

℞.	Sulphur. sublimat.,	
	Ol. rusci	āā ℥ss
	Cretae praeparatae	ʒj
	Saponis mollis,	
	Adipis	āā ℥j

It is often used in half strength on children and women.

The method of applying the ointment should be fully explained to the patient, preferably in writing. Before the first application, the skin is bathed in hot water with tar soap, being soaped for fifteen minutes and then thoroughly scrubbed with a washcloth or soft brush for ten minutes. The skin is then dried and the ointment is rubbed into all parts except the face and scalp, particular attention being given to the armpits, navel, genitals, and interdigits. In infants even the face and scalp must be treated, but the hands and feet should receive the most attention.

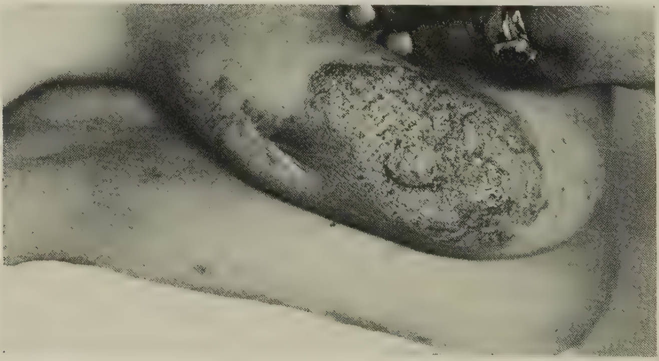

Fig. 731.—Scabies, showing eczematous condition of the nipple of the female breast.

Following the first application, the ointment should be rubbed in twice daily, morning and night, but chiefly at night. There are conflicting opinions regarding bathing during this period, but patients are usually more comfortable if they bathe once a day, at night, before the ointment is applied. This bath should not be vigorous, irritation to the skin from excessive scrubbing being carefully avoided. No brush should be used and cleansing should be limited to a gentle wash with tar soap, hot water, and a washcloth.

After the first night the itching is generally relieved and after four or five days of treatment all evidences of the disease usually disappear. At this time it is advisable to reduce the applications of ointment to once daily, sparingly. This routine should be continued for one week.

Ehler suggested the following ointment which is applied after a hot bath with soap and water and is left on for twenty-four hours, at which time a second bath is taken. The single application is usually sufficient to cure the disease, and the method is highly recommended by Lomholt, who treated 678 cases with it, and by others. For the preparation of the ointment[1] the following directions are given:

1. One kg. of sublimated sulphur is dissolved at gentle heat in 2 kg. of a 50 per cent solution of potassium hydroxide. This makes a clear, yellow solution.
2. Two hundred and twenty-five Gm. of vaselin and 225 Gm. of water-free lanolin are carefully mixed, without heating.
3. To this mixture 375 Gm. of the solution of sulphur in potash-lye, mentioned above, is added.
4. Fresh zinc hydroxide is prepared in mixing 28 Gm. of zinc sulphate and 40 Gm. of 20 per cent sodium hydroxide, and this is afterward added to the ointment.
5. Liquid paraffin is added to obtain a total weight of 1000 Gm.
6. Five Gm. of benzaldehye (or 5 Gm. of oil of bitter almond) is added to check the somewhat disagreeable odor of sulphuretted hydrogen.

In the event of sulphur dermatitis, all preparations containing sulphur must be discontinued. Frequently patients have sulphur dermatitis combined with scabies when they first apply for treatment, due to the friendly help of some incautious druggist. When the dermatitis is severe, it is necessary to stop the antiparasitic remedies entirely until the irritation from the sulphur has subsided from the use of an ointment consisting of anhydrous lanolin, 1 ounce, and solution of aluminum acetate, 2 drachms, and of fractional doses of roentgen rays. In cases of scabies complicated by a mild form of sulphur dermatitis, antiparasitic treatment need not be interrupted; but balsam of Peru, 5 to 10 per cent ointment, is substituted for sulphur.

Although ointments are usually preferable for the treatment of scabies because of their greater penetrating powers, the personal objections of the patient sometimes outweigh such considerations. Various substitutes are used with more or less success. The simplest is to dust the skin after each bath and the sheets with precipitated sulphur (flowers of sulphur). Vleminckx's solution (N. F.) and Mitigal (Winthrop Chemical Company) do not possess the unpleasant properties of ointments, but the former has an acrid odor and is irritating, whereas the latter can be recommended. Colloidal sulphur gives good results if rubbed directly into the skin; it may also be placed in baths. Treatment by vapors from a sulphur candle is somewhat ineffective and dangerous. Balsam of Peru, pure or mixed with equal parts of castor oil, glycerin, or alcohol, may be painted upon the skin.

TICKS

Synonyms.—Wood-ticks, Ixodes, Ixodoidea.

Several varieties of ticks occasionally attack the human skin. In this country the wood-tick is the chief offender, having its habitat in wooded districts, being found especially on pine trees and in the underbrush. The eggs are laid in the grass or bushes, from which man usually picks up the infection.

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[1] The formula was devised by Mr. Marcussen of Professor Ehler's Clinic—Lomholt, S.: The Danish Treatment of Scabies, Lancet, 2: 1251, Dec. 18, 1920.

In Africa the spirochetes of relapsing fever are transmitted by a variety of tick. The female tick attaches itself to the skin by sticking its proboscis into it to suck blood from the superficial vessels. The parasite is engorged after two or three days so that it falls off or can be easily removed. If an attempt is made to detach the tick prior to this time, the head is likely to be broken off and left in the skin, unless the tick is paralyzed by the application of a few drops of benzine or tobacco juice. The insertion of the proboscis is generally unnoticed by the subject, but in a few hours there appears an urticarial wheal at the place of puncture, which usually itches and is painful for several days. Soothing antipruritic lotions are used to allay these symptoms.

DEMODEX FOLLICULORUM

Synonym.—Acarus folliculorum.

The Demodex folliculorum is a worm-like acarus of microscopical size which infests the sebaceous follicles, usually of the face. The parasite has a flattened head and on the ventral aspect of the body has four pairs of legs, behind which is an elongated abdomen. The parasite is not an infrequent habitant on coarse oily skin, but is not encountered in infants. It is generally considered harmless although cases of facial hyperpigmentation and impetigo have been ascribed to it and it has been suggested that the chronic irritation resulting from its presence may lead to the development of epithelioma. In one of my patients who had a scaly erythematous patch on the upper arm which clinically suggested tinea circinata, Birkman recovered numerous parasites. Ayers has reported several cases in which there were finely scaling, stippled patches on the skin due to demodex. The patients were chiefly women who cleansed their skin solely by creams. The parasite is easily exterminated by the frequent use of soap and water and by ammoniated mercury ointment.

HARVEST BUG

Synonyms.—Leptus, harvest mite.

This is a common parasite whose activities are often mistaken for chigoe itch. The mite is of a red color and 0.3 to 0.5 mm. in length. Several varieties exist. The attacks occur chiefly during the summer and fall, due to infection from grass and bushes. The lesions occur chiefly on the legs and occa-

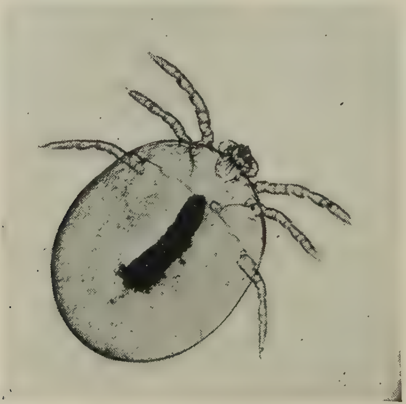

Fig. 732.—Harvest bug (Trombicula irritans) (× 65). (Courtesy of Army Medical Museum.)

sionally on the upper extremities, and they consist of hemorrhagic puncta surrounded by red swellings. At times there are scratch marks, urticarial lesions, and crusts. The itching is relieved and the parasite exterminated by the use of 5 to 10 per cent sulphur ointment containing 1 per cent phenol.

FOWL MITE

The fowl mite is a red parasite which lives on birds and occasionally infests man. Those who handle poultry are especially liable to the affection, which occurs chiefly on the hands and arms. The bite produces an inflammatory, itchy papule. The parts should be thoroughly scrubbed with soap and water and massaged with sulphur ointment containing menthol and phenol as antipruritics.

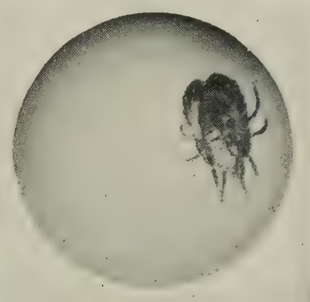

Fig. 733.—Tropical fowl mite (Lipanyssus burra); female. (Courtesy of Army Medical Museum.)

COPRA MITE

Cutaneous lesions produced by a mite which lives in copra were described by Castellani in Ceylon, most of the cases occurring as inflammatory and urticarial papules on the extremities and trunk, with a distribution simulating scabies. The disorder has been encountered in temperate climates among those who handle shipments of cocoanut or copra from the Tropics. Treatment with 5 to 10 per cent beta-naphthol ointment is advised by Castellani.

GRAIN-ITCH MITE

Synonyms.—Pediculoides ventricosus, straw itch, barley itch, mattress itch, prairie itch.

This small mite lives in grains and may temporarily attack the human skin. Those chiefly affected are harvesters of wheat, barley, oats, and other cereals, or farm hands and packers who have contact with straw. Grain itch, as the affection is popularly called, develops as a pruritic papulovesicular, urticarial or vesicopustular eruption on the face, hands, arms, chest, and back and in severe cases may be generalized and lead to some constitutional disturbance. Mild antiparasitic ointments containing sulphur are specific remedies.

Prairie itch is the term used in the West for an itching affection known as "Texas mange," "swamp itch," and "lumberman's itch." The term is of general application and indicates no special skin disease, but is used chiefly in reference to grain itch and scabies.

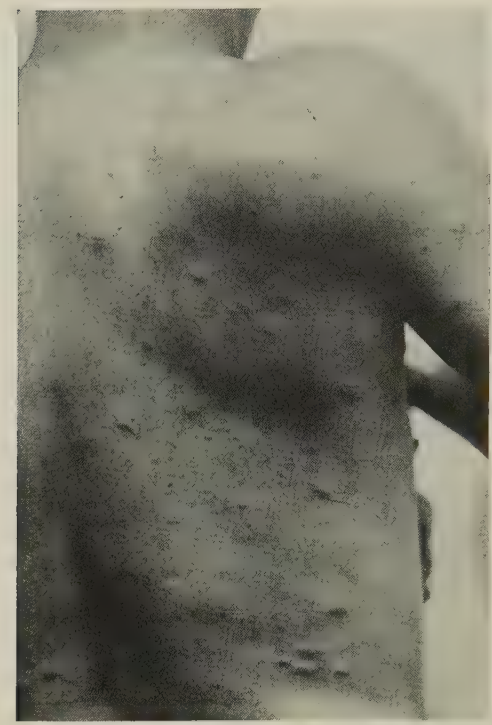

Fig. 734.—Grain itch. One of a number of patients with grain itch appearing as an outbreak in an institution from the use of new straw mattresses. (Courtesy of Dr. Joseph V. Klauder.)

CENTIPEDE

Synonym.—Chilopoda.

Centipede bites are manifested by hemorrhagic puncta surrounded by an erythematous swelling which may progress into a brawny edema or lymphangitis, and lymphadenopathy. Locally there may be intense itching and pain, sometimes associated with septic constitutional symptoms.

PEDICULOSIS

Synonyms.—Phthiriasis, lousiness.

Under the term "pediculosis" are included those conditions of the skin that are due to the presence of lice. Three varieties of pediculi commonly attack man although others infest the lower animals and may become temporarily deposited upon human hosts. The three varieties which attack man are named according to the areas which they usually involve—Pediculus capitis (head louse), Pediculus corporis (body louse), and Pediculus pubis (pubic louse or crab louse). Each of the varieties of pediculi has a predilection for certain parts of the skin and rarely migrates to other regions. These pediculi attach themselves to the skin and live upon the blood which they suck from it. In piercing the skin the parasites exude a poisonous salivary secretion. This, together with the mechanical puncture, produces a pruritic dermatitis, which may become secondarily infected by pyogenic cocci as the result of scratching. In addition to causing these effects, the louse is a carrier of disease germs, and through its bite or excretions an infectious disease may be transmitted—typhus, relapsing fever, or trench fever.

The pediculi have oval grayish bodies, which become reddish when they are engorged with blood. The Pediculus corporis is the longest (2 to 4 mm.) and the Pediculus pubis is the shortest (1 to 2 mm.) and the broadest, being nearly as wide as it is long. The females are larger than the males, and they proliferate rapidly, becoming sexually mature in less than two weeks and hatching out in one week. The ova (nits) are oval grayish shiny specks, the size of a pinhead, which are firmly attached to the hairs in an oblique manner, so that they look like little fly-wings, but are thicker when felt; and do not rub off like dandruff. Several may be attached to one hair at various distances along the shaft.

Pediculosis Capitis.—This is the most common variety of pediculosis and is encountered principally in children and sometimes in women. There is usually an intense pruritus of the scalp and the affected hairs become lustreless and dry. Due to the itching, secondary complications with impetigo and furunculosis are common. The pediculi may be seen on the scalp, but more often only the nits are visible, which are located chiefly on the hairs above the ears and on the occiput an inch or so from the scalp. In severe cases the scalp becomes covered with epithelial débris and bloody scabs, and the hairs become matted together with dirt and pus and may, when there is long hair, even form a malodorous rope—plica polonica. Due to secondary infection, the cervical lymph glands become enlarged and the general health may be impaired from septic absorption.

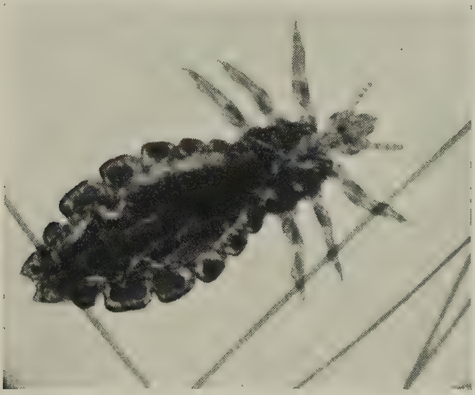

Fig. 735.—Head louse (Pediculus capitis). Several human hairs show in the photograph. (Courtesy of American Museum of Natural History.)

Diagnosis.—The diagnosis usually presents no difficulties, but occasionally pediculi and nits are so sparse that repeated examination is necessary to discover them. The disease should be suspected in all cases of impetigo and furunculosis in children. Of course, in pityriasis sicca and pustular eczema of the scalp the pediculi and ova are absent. It is important not to mistake epidermal scales encircling hair shafts or trichorrhexis nodes, for nits.

Treatment.—Treatment of pediculosis of the scalp aims at the destruction of the pediculi and the ova. When there is profuse involvement in long-haired children, clipping the hair is advisable as it saves much time. Treatment must be thorough. To accomplish this the scalp is thoroughly soaked in equal parts of crude petroleum and olive oil and is bandaged loosely for twenty-four hours. This mixture dissolves the glue which holds the nits to the hairs and at the same time kills the lice. The mixture is inflammable, for which reason a certain degree of caution is necessary. The treatment is made more effective by covering the bandage with a comfortably fitting bathing cap. Other solvents are xylol, benzene, kerosene, and hot vinegar. The nits are removed by a fine-toothed comb, day after day until they are all gone. The scalp should be shampooed daily until the disease is eradicated and after that, once weekly, at which time the hair should be gone over with a fine-toothed comb, and moistened with a lotion containing bichloride of mercury, 1 : 1000, a small amount of castor oil, and dilute alcohol.

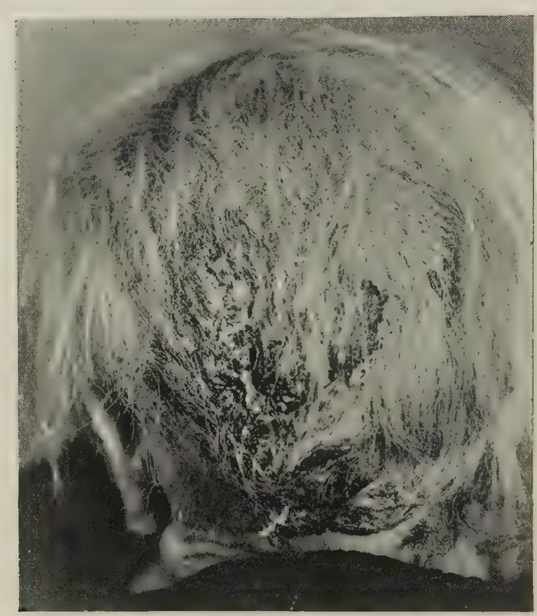

Fig. 736.—Pediculosis capitis.

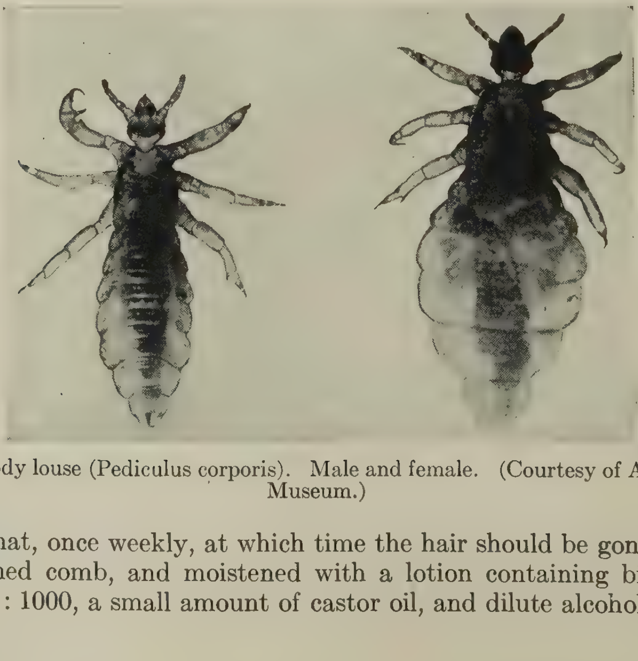

Fig. 737.—Body louse (Pediculus corporis). Male and female. (Courtesy of Army Medical Museum.)

Pediculosis Corporis.—(Pediculosis vestimentorum, vagabond's disease.) The lice in this condition live chiefly in the seams of the undergarments, particularly wherever there is pressure, as beneath the belt or the collar. The parasite is rarely discovered on the skin, but obtains its nourishment from it by clinging to the underwear, rotating its head and piercing the skin with its proboscis. Occasionally the nits are found on the pubic and lanugo hairs. Pediculosis corporis is found most often in aged people and in persons in congested encampments. The affection causes generalized itching, which may be accompanied by erythematous macules or urticarial wheals due to the punctures, or by parallel linear scratch marks and a pigmented thickening of the skin from continued rubbing. Secondary staphylococcic infection is common.

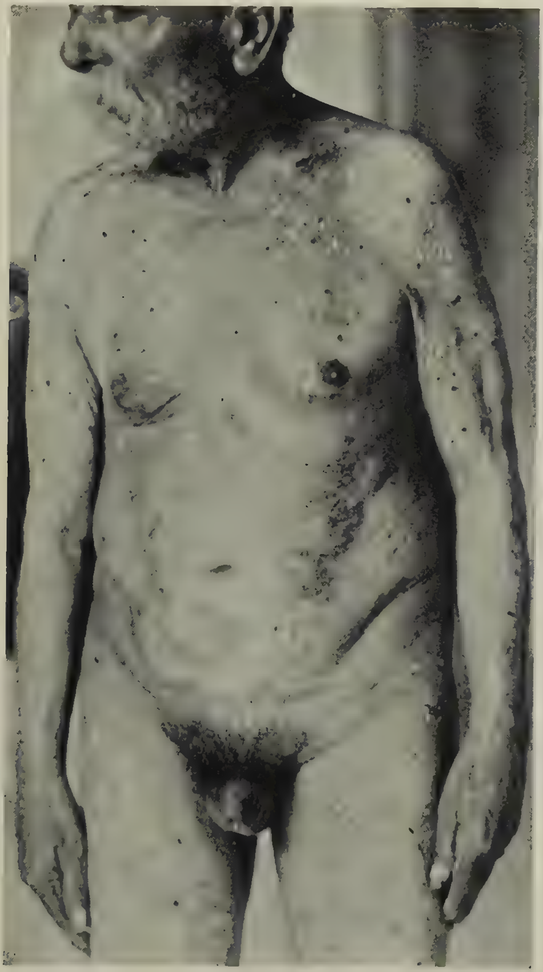

Fig. 738.—Pediculosis corporis. Note that the face is free of involvement. (Courtesy of Drs. J. B. and Bedford Shelmire.)

Diagnosis.—The diagnosis is, as a rule, readily established by the generalized itching, by parallel scratch marks on the shoulders, by hyperpigmentations, and erythematous macules. It is differentiated from scabies by the freedom of the hands and feet from involvement and by its predilection for the upper back. Pruritus and urticaria may cause some confusion. The diagnosis is positively established by finding the lice or nits in the seams of the underclothes.

Treatment.—Destruction of the lice is accomplished by boiling the undergarments. After this the underwear as well as the outer clothes should be pressed with a hot iron, especially over the seams. The patient should be given a thorough bath with soap and water, followed by a sponge with benzine. An effort should be made to remove any hairs to which nits are attached. Antiparasitic powders containing pyrethrum, naphthalin, and camphor should be used upon the clothes as a protective. N. C. I. powder containing creosote, 2 per cent; iodoform, 2 per cent, and naphthalin, 96 per cent, is highly recommended. Special methods are applicable to disinfection of large bodies of troops, the clothes being treated by steam under pressure.

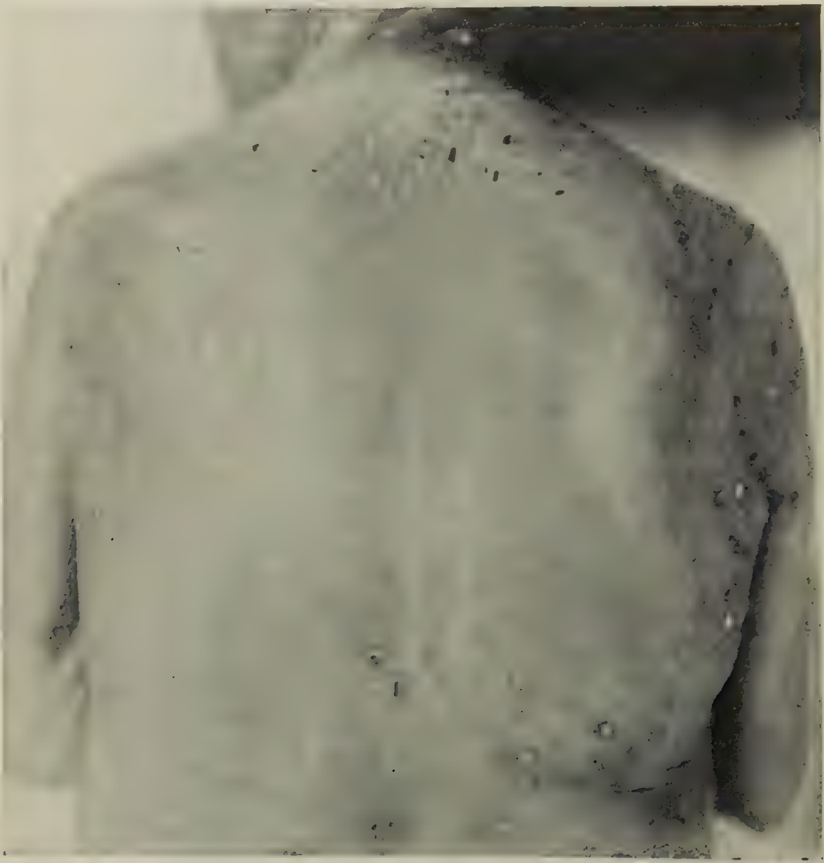

Fig. 739.—Pediculosis corporis. Note that the center of the back, which the patient cannot reach, is free of the eruption; also, the parallel scratch marks on the shoulders. (Courtesy of Drs. J. B. and Bedford Shelmire.)

Pediculosis Pubis.—(Crabs.)

This affection is contracted chiefly by adults as the result of sexual intercourse, but not infrequently from toilets and other sources of infection. The

Pediculus pubis, or crab louse, usually limits its incursions to the genital region and hypogastrium, but it may migrate to the armpits, eyebrows, and indeed to any part of a hairy person. The lice are found on the skin, to which they adhere, appearing as yellowish or gray specks. Being almost the color of the skin they are difficult to identify, and for this reason the affection may exist a long time before its recognition. The nits are attached to the pubic hairs about $\frac{1}{2}$ inch above the skin; and rust-colored or reddish speckles due to excrement may be seen. The symptoms vary from slight discomfort to intolerable itching. Apparently, some persons who have delicate skins are more irritated by the disease than others whose symptoms are so slight that they make no complaints.

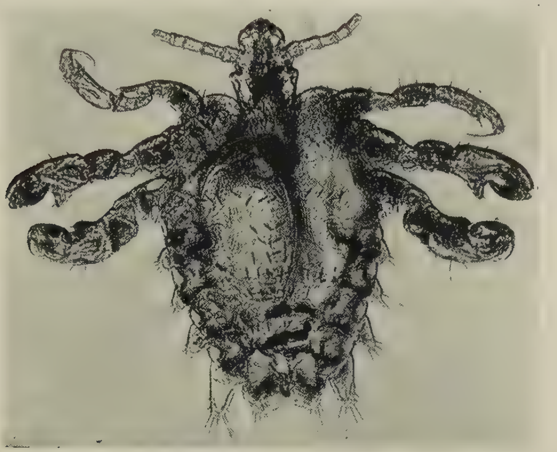

Fig. 740.—Crab louse (Pediculus pubis) (× 70). Female. (Courtesy of Army Medical Museum.)

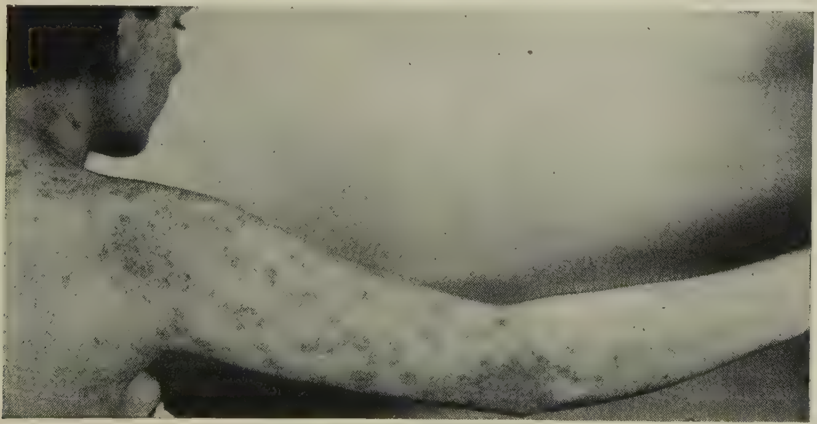

Fig. 741.—Maculae caeruleae.

Occasionally, peculiar bluish or slate-colored macules which do not itch or disappear on diascopic pressure occur in association with pediculosis pubis. These macules are about $\frac{1}{2}$ cm. in diameter and are located chiefly on the sides of the trunk, and on the inner aspects of the thighs, being more noticeable in blondes. These spots are called maculae caeruleae and are caused by a secretion of the pediculi which is forced into the skin when the parasite is feeding.

Treatment.—This consists of destruction of the lice by tincture of larkspur, benzine, or kerosene. To avoid undue irritation, these chemicals may be mixed with equal parts of olive oil. The area should be thoroughly washed and rid of nits by pulling out hairs which are affected or by shaving the parts. Two per cent ammoniated mercury ointment may be used daily on the areas. If the skin has been badly irritated by previous injudicious treatment, as is often the case, shaving is recommended. When the eyelashes are affected, the parasites and ova should be picked off with forceps and 2 per cent yellow oxide of mercury ointment should be applied.

BEDBUG

Synonym.—Cimex lectularius.

The bedbug is distributed in all parts of the world, and hides in crevices during the daytime and seeks human skin at night in order to obtain nourishment. When the bedbug punctures the skin it forces a vasodilating, irritating substance into it, which causes an urticarial or purpuric reaction about the puncta. One bedbug may produce several bites in the course of the night, chiefly on the ankles and buttocks, these sometimes being arranged in a line.

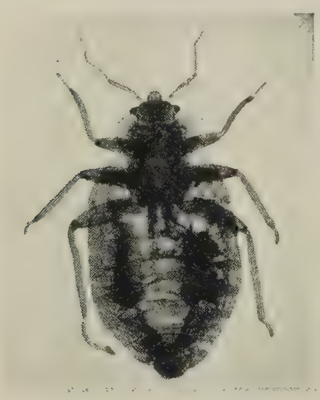

Fig. 742.—Bedbug (Cimex lectularius) (× 10). (Courtesy of Army Medical Museum.)

Treatment is by the use of soothing antipruritic lotions containing menthol, phenol, and camphor. Crevices in the furniture, floor, and walls should be sprayed with kerosene or filled with solution of bichloride of mercury (1 : 1000); and guaiacol powder should be dusted between the sheets.

FLEAS

Synonym.—Pulex irritans.

Fleas exist universally among animals and occasionally lodge as parasites on human beings. They extract their food from the superficial capillaries, causing hemorrhagic puncta surrounded by an erythematous and urticarial patch. Extensive involvement may cause numerous lesions of this type and may be associated with factitious urticaria, scratch marks or furunculosis; or it may closely resemble purpura. The irritation is produced by the injection into the skin of a fluid secreted by the salivary glands of the parasite. Some persons have an apparent hypersensitiveness to this secretion and are more afflicted by the flea bites than others. In addition to the distress caused by their bites, fleas may transmit bacterial diseases, as illustrated by the rat flea, which transmits plague.

Treatment is by soothing lotions containing phenol, camphor, and menthol. For prophylaxis the skin may be dusted with powdered camphor or naphthalin or one or two small bags containing these substances may be worn in the underwear.

CHIGOE

Synonyms.—Chigoe itch, sand flea, Pulex penetrans, Tunga penetrans.

The sand flea is a minute parasite encountered chiefly in tropical countries, but occasionally in temperate climates. In appearance it resembles the common flea. It attacks the skin of man, as well as that of the lower animals, the female penetrating in an oblique manner, so that burrows are formed for deposition of the ova. Lesions usually occur on the feet and ankles, particularly about the toe-nails, and less often about the anus or genitals. Frequently the lesions become secondarily infected by staphylococci with the formation of pustules, crusts, and ulcers.

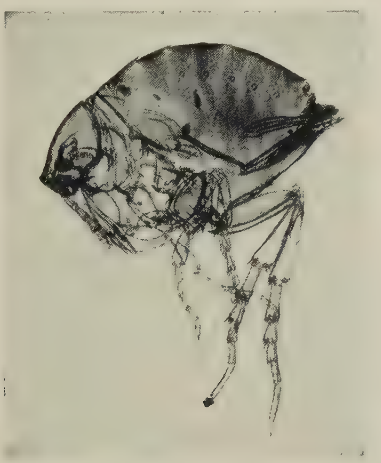

Fig. 743.—Chigóe flea (Tunga penetrans) (× 50). (Courtesy of Army Medical Museum.)

The **treatment** is by a thorough bath with strong soap followed by the forceful extraction of the flea if it has penetrated the skin. This may be accomplished with a flat needle and should be followed by an antiseptic dressing. In regions where the disease is prevalent it may be prevented by the use of pyrethrum powder upon the walls, the floors, and the furniture. In this country harvest-bug itch is often mistaken for chigoe itch.

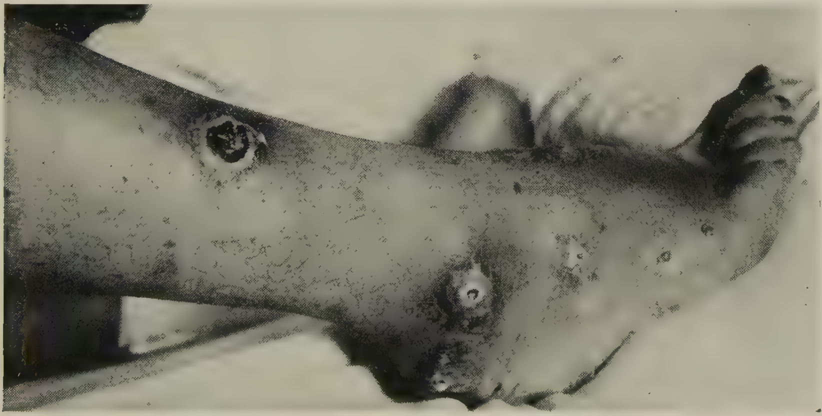

Fig. 744.—Chigoe itch. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

MYIASIS

Various cases of disease caused by the larvae of flies have been described. The eggs are deposited on the skin or mucous membranes where they hatch and produce larvae which burrow into the skin and cause mild or severe inflammatory changes. Some varieties of flies puncture the skin and extrude the ova beneath the surface, whereas others deposit their eggs on open wounds or ulcers. The larvae hatch out on the skin and maggots crawl about in the dirty ulcerated area. The chief variety of insects that cause dermal myiasis is the screw-worm fly (Chrysomyia macellaria). This disease occurs in tropical South America, in Central America, and the southern United States; cases have been reported from as far north as Alaska. Next in importance in this country is the *Phormia regina Meig.*, which affects principally goats and sheep, and occasionally man. This fly is common around houses, privies, and packing establishments. Many cases in Central America and the southern states are also caused by the Dermotobia cyaniventris.

In tropical Africa the tumbu fly, or Ver du Cayor (Cordylobia anthropophaga), produces much the same results. The eggs are first deposited on the ground, and the active young maggot attacks and penetrates the skin of its host, especially on the forearm, scrotum, upper part of the thigh, and the buttock. The lesion resembles an inflamed tumor, from which the larvae emerge in six or seven days. In the ordinary course of events these tumors do not suppurate. The fly usually attacks other mammals besides man.

Treatment must be prompt as in neglected cases the outcome is often fatal. Early lesions should be widely opened and curetted, visible larvae being removed by forceps. Complete excision should be done when feasible. The resulting wound should be irrigated with antiseptic solutions. MacLeod recommends swabbing the cavity with benzine.

HOOKWORM DISEASE

Synonyms.—Ground itch, water itch, coolie itch, uncinarial dermatitis, uncinariasis, ancylostomiasis, mountain anemia.

Hookworm is a specific communicable disease which is due to infection with the larvae of Ancylostoma duodenale or Necator americanus. The disease is prevalent in most tropical and subtropical countries and is often endemic in most swampy and sandy localities in the temperate zones. In these latter regions the larvae are killed off each winter, but the soil becomes contaminated from human sources in the summer.

Etiology.—According to Ashford, the adult worm is a little over $\frac{1}{2}$ inch in length and of the thickness of a hair. The female produces about 9000 eggs a day, which are incapable of developing into larvae until they reach the soil, where under propitious circumstances they attain the stage of infective larvae in about twenty hours. These tiny larvae, which can scarcely be seen with a small pocket lens, coming into accidental contact with the bare feet, penetrate the skin and reach the capillaries. They are carried in the circulation to the lungs, where they penetrate through the capillary walls into the bronchi; they pass up the trachea to the pharynx and, being swallowed, eventually reach their habitat in the small intestine. Here they bury their heads in the mucosa and begin their sexual life.

The earliest skin lesions (ground itch) are erythematous macules and papules, which in a few hours become vesicles. These itching lesions usually occur on the soles, in the interdigits, and on the ankles, and they may be scattered or in groups. The contents of the vesicles rapidly become purulent.

These lesions are produced by the invasion of the skin by the ancylostoma larvae, and precede the generalized symptoms of the disease by two or three months.

The onset of the constitutional disease is insidious and accompanied by "progressive anemia, debility, and various digestive, circulatory, and nervous disturbances in cases sufficiently infested to produce a definite clinical picture; by under-development of children, reduced resistance to other diseases, lack of mental alertness, and physical vigor."

After the disease is fully developed, ulcerations of the legs are common. These ulcers are, as a rule, irregularly oval, indolent excavations on the shins, several centimeters in diameter. The bases are dirty, being covered with a purulent exudate which contains flecks of necrotic tissue. The edges are rounded, often slightly elevated or undermined.

Treatment.—Treatment is by expulsion of the parasites from the body brought about by the aid of certain chemicals and by prevention through a proper disposal of human feces. The chief drug employed is carbon tetrachloride, which is combined with oil of chenopodium in a mixture of two parts of the former to one of the latter; 2.5 to 3 cc. of this mixture is an adequate dose for an adult male, and 1/18 of this dose for each year of age is suitable for a child. According to Lamson, intoxication from carbon tetrachloride has been shown to be due to the following complications: Irritation or mechanical obstruction by ascarids, chronic or acute alcoholism, the presence of undigested food in the intestinal tract, and calcium deficiency. The intoxication can probably be prevented by avoiding the administration of carbon tetrachloride to patients with ascariasis without preliminary treatment for roundworms, by refusing treatment to alcoholic addicts, by having the patient avoid alcohol or food shortly before and after carbon tetrachloride administration, and by insuring an adequate calcium reserve in all persons treated. The toxic effects are largely due to the action of the drug on the liver and in severe cases can be controlled by the intravenous administration of 5 per cent glucose solution. Other remedies used in the treatment of ancylostomiasis are thymol, oil of chenopodium and beta-naphthol. Prophylaxis is largely a community problem, which depends upon the prevention of fecal contamination of the soil and water.

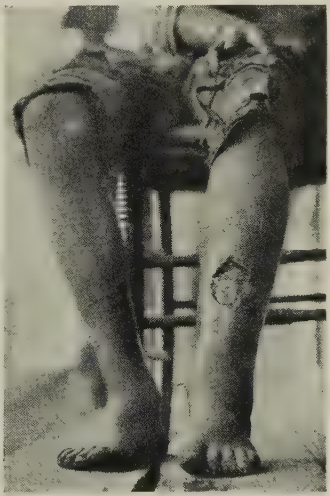

Fig. 745.—Case of hookworm disease with ulcer of leg. (Courtesy of Dr. Robert A. Lambert.)

CREEPING ERUPTION

Synonyms.—Larva migrans, myiasis linearis.

Creeping eruption is a term applied to a number of affections of the skin characterized by their tortuous migratory lesions produced by the burrowings of larvae. Through the investigations of Kirby-Smith, Dove and White, and of Shelmire, it has been shown that the majority of cases in this country are due to penetration by the larvae of a cat- and dog-hookworm, Ancylostoma braziliense, acquired from bodily contact with damp sand or earth contaminated by excreta of dogs and cats. A similar dermatitis is produced by the larvae of Ancylostoma canium, which infests the dog and the cat. In the Orient there have been reported cases of human creeping disease due to pig and cat nematodes of the genus Gnathostoma; larvae of the horse botfly or Gastrophilus have been reported in 7 cases of creeping eruption. In cases reported by Topsant and others, the Hypoderma linearis was the causative parasite. The larva of Strongyloides was recovered in 1 case.

The onset is characterized by slight local itching and the appearance of papules at the sites of infection due to the migrations of the larvae in their burrowings. Intermittent stinging pain occurs and thin red tortuous lines are formed in the skin. In experimental cases the migrations began about four days after the inoculation and progressed at the rate of 1 or 2 inches a day. The linear lesions are often interrupted by papules which mark the sites of resting larvae. As the eruption advances the old parts tend to fade, but there are sometimes purulent manifestations due to secondary infection with staphylococci. If the progress of the disease is not interrupted by treatment it may extend for several years. At times the larvae are removed from the skin by the finger-nails in scratching. A moderate eosinophilia may be present.

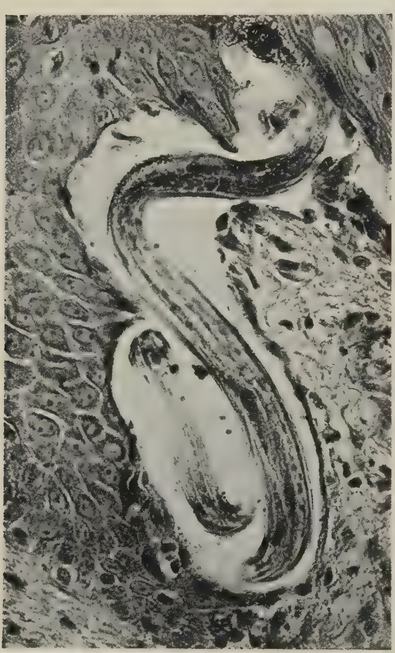
Fig. 746.—Ancylostoma braziliense. Photomicrograph showing nematode in burrow in skin, × 480. (Courtesy of Drs. J. Lee Kirby-Smith, W. E. Dove, and G. F. White.)

Treatment.—The disease is often refractory to treatment, and, on the other hand, there seem to be cases of spontaneous healing. The most accurate procedure has been suggested by Austmann and is based upon Lombard's method of observation of the capillaries by clearing the epidermis with oil. Ordinary clear machine oil was applied to the skin at the end of the red line and the area was studied with a binocular dissecting microscope of a magnification of twenty diameters. The parasite was discovered at a distance of 13 mm. from the end of the red line and off to one side, and seemed to lie between the corneal layer and the granular layer of the epidermis. On the magnification being increased to 150 diameters and by employment of strong direct illumination of the field, the head and other details of structure could easily be discerned. Four hours later Austmann found that the larva had advanced 8 mm. He conclusively showed that even with a small pocket lens there was no difficulty in finding the parasite and keeping it under observation during extraction where oil was used to clear the epidermis. The larva was readily removed with the point of a needle and without the use of any local anesthetic. Even the lens could be dispensed with as the larva was easily visible through the clear horny layer. No skin capillaries were injured during the extraction and the patient was practically unaware of the operation.

Of the other methods of treatment the best results are obtained by freezing the larvae with ethyl chloride and by fumigation with ethyl acetate. The position of the parasite is determined as carefully as possible by inspection, aided by diascopic pressure, which reveals the larva as a dark brown speck beneath the glass. The affected area, about the size of a twenty-five-cent piece, is then frozen with a spray of ethyl chloride for thirty seconds, and this is repeated two or three times during the twenty-four hours. Carbon dioxide snow may be substituted for ethyl chloride, but is more painful and will leave scars. The chief difficulties in the way of successful treatment arise from the uncertainty regarding the precise location of the parasite and, when it is found, from the inability to keep it in view during extraction.

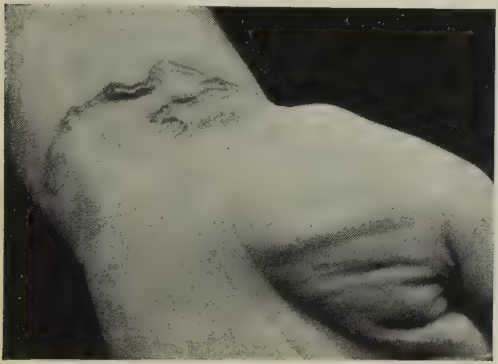

Fig. 747.—Creeping eruption. Lesions on the wrist. (Courtesy of Drs. J. B. and Bedford Shelmire.)

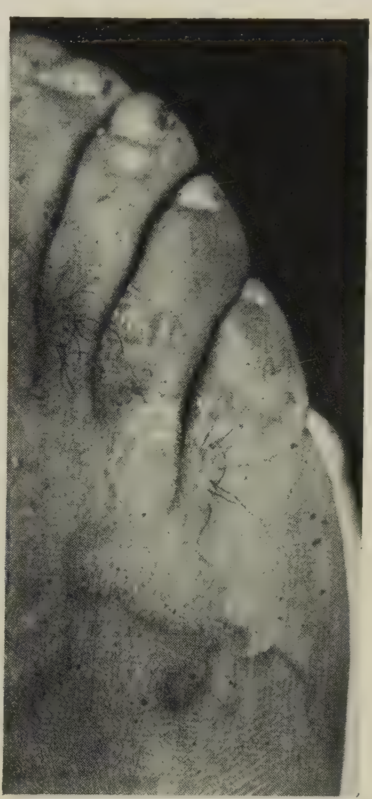

Fig. 748.—Creeping eruption. Characteristic lesions on foot. Note vesicles along line of migration. (Courtesy of Dr. J. Lee Kirby-Smith.)

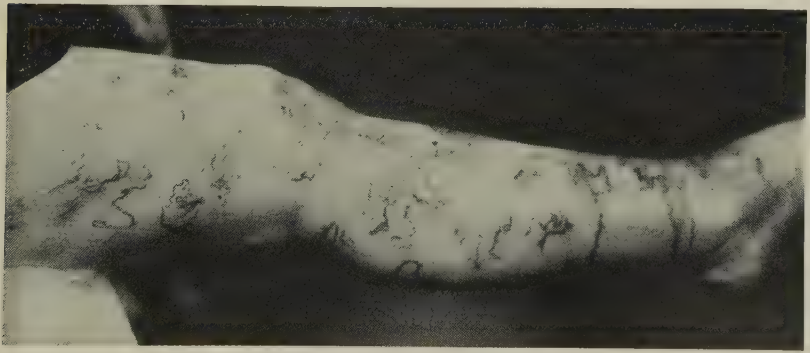

Fig. 749.—Creeping eruption of three weeks' duration. Both legs involved, several hundred lesions being present. Infection from crawling under house for chicken eggs. (Courtesy of Dr. J. Lee Kirby-Smith.)

Electrodesiccation along the course of the eruption and for some distance beyond its ends is a method which has been used with success by my associate, Dr. Birkman. No anesthesia is required for this treatment, although it is slightly painful.

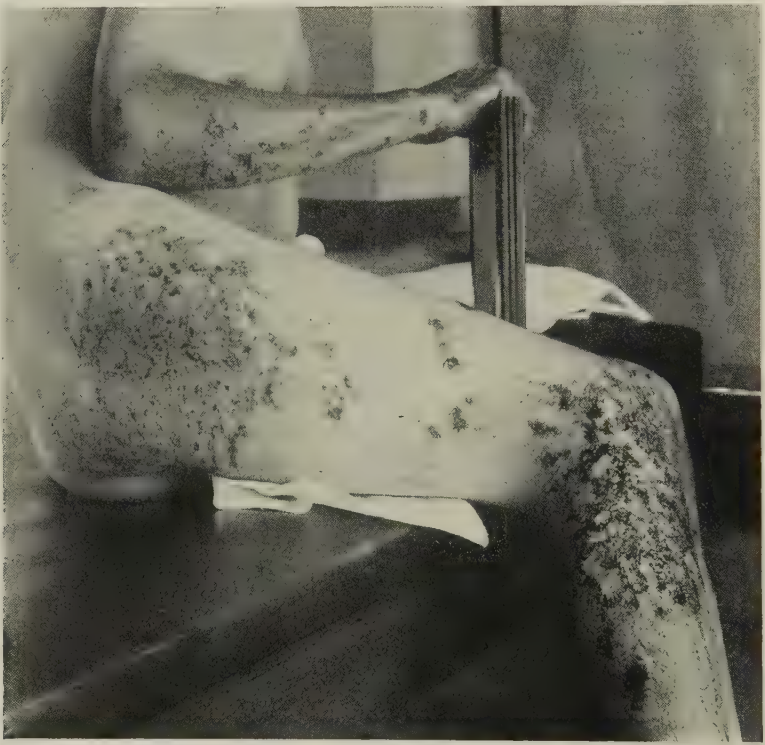

Fig. 750.—Extensive creeping eruption. Trunk also involved. (Courtesy of Dr. J. Lee Kirby-Smith.)

Other methods of treatment include the excision of the areas of involved skin, which is painful, uncertain, and an unnecessarily drastic procedure. Intracutaneous injections of cocaine solution followed by a few drops of chloroform or ether have been recommended, as have also curettage of the supposed site and the painting with phenol.

CYSTICERCUS CELLULOSAE

The larvae of the tapeworm may burrow into the human skin and form rounded tumors, which are often multiple and may persist for indefinite periods. The lesions are more or less stationary and are largest where the parasite is still alive. The nodules are sometimes painful and may ulcerate or become absorbed or calcified. The disease is most prevalent in countries where pork is eaten. It may be confused with gumma, lipoma, and epithelioma. A positive diagnosis is established solely by incision and examination of the interior of the tumor, where the parasite will be found.

OTHER ANIMAL IRRITANTS

Other insects more or less commonly sting or bite the skin and thus produce cutaneous lesions. Mosquitoes and gnats inject an irritating fluid under the skin before sucking the blood and this provokes a pruritic urticarial wheal or less often a blister, a diffuse swelling or lymphangitis. Similar lesions are caused by black flies and jelly-fish. Bees and wasps cause even more severe symptoms, and in aged people they may be alarming. Some varieties of ants, caterpillars, spiders, and beetles give rise to more or less similar lesions.

The first step in treatment is to pull out the sting when it has been left in the flesh. Then a local antiseptic should be applied, such as tincture of iodine, and subsequently the inflammation should be controlled by ice-cold compresses or astringent lotions containing 2 per cent phenol, 2 per cent camphor, and 1 per cent menthol. If there are general symptoms, brandy or strychnine should be given.

RAT-BITE FEVER

This disease occurs chiefly in Japan and is characterized by fairly distinctive, erythematous, indurated plaques in the skin, which become exacerbated with each rise of temperature. The onset is ten to thirty days after a bite by a rat, cat or dog, when constitutional symptoms of general infection supervene. There is a fever which is intermittent at intervals of two to seven days. If the disease remains untreated, the course is prolonged and it may last for six months. The etiologic agent is probably the Spirochaeta morsus muris. Rat-bite fever must be differentiated from erysipelas, giant chancre, pyogenic cellulitis, and leprosy. Treatment is by intravenous use of arsphenamine. to which there is a prompt response.

AMEBIASIS CUTIS

Amebic infection of the skin is a rare condition which is encountered chiefly in the Tropics. A few cases are reported in the English literature, especially one described by Engman and Heithaus, in which there were multiple ulcerations on the trunk, buttocks, and legs. These began as deep abscesses, which after rupture formed indolent, oval, and serpiginous ulcers, several centimeters in diameter. The edges were raised, cordlike and undermined; the base was covered with necrotic tissue and glairy pus in which Amoebae were demonstrated. The presence of dysentery and the discovery of Amoebae in the feces led to examination of the skin lesions for their presence.

Heimburger reported amebiasis cutis in a Chinese farmer. The local condition was an ulcer, 12 cm. by 6 cm. and 4 cm. deep, in the right lumbar region. The edges were indurated, everted, and raised above the surrounding skin, and were encircled by a dark brown border of hyperpigmentation, 2 cm. wide. The base was composed of dark red granulation resembling raw beef which has been exposed to the air for some time, being covered by thick brownish, blood-tinged pus, and necrotic material. The border of the ulcer was elevated and distinctly hard on palpation. The lesion was painful and malodorous. Amoebae were found in stained specimens of the tissue and in smears from the pus, and were observed in the living state on the warm stage. These in every respect resembled Amoeba histolytica. These findings, together with a history of chronic dysentery, and intense pain in the right hypochondrium—which was relieved after the rupture of a skin abscess that preceded the ulcer—pointed to a diagnosis of amebic infection of the skin due to contamination from the discharge from a sinus leading into an abscess of the liver, which was substantiated by careful probing. Similar cases have been recorded by Maxwell, Daborn and Heymann, Carini, and Gauducheau, which are described in Dobell's book.

Treatment is by hypodermic injections of emetin. According to Heimburger this drug in sufficient quantities is a specific for this disease and acts with astounding rapidity.

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CHAPTER XXVII

TROPHIC DISTURBANCES

MANIFOLD hypertrophies occur; those of congenital origin are described in the chapter on Diseases of Congenital Origin, and others are discussed in the chapters on Benign and Malignant Neoplasms. Several hypertrophies remain and will be considered here.

SCLERODERMA

Synonyms.—Hidebound skin, sclerema adultorum, morphea, scleriasis, dermatosclerosis.

This affection is a chronic disturbance of the skin characterized by the appearance of circumscribed or diffuse, hard, smooth, ivory-colored areas, which are immobile upon the underlying tissues and are generally surrounded by a violaceous margin. The appearance varies according to the site of involvement, and the stage and extent of the disease. In the earlier phases the affected areas are usually erythematous and swollen, but atrophy soon supervenes, and the skin becomes smooth, yellowish, and firm, and retracts so that the underlying structures are bound down. In the diffuse form the earliest changes are likely to occur insidiously upon the face and hands, and in more advanced stages these parts become "hidebound," so that the face is expressionless, there is difficulty in opening the mouth to take nourishment, and the hands are claw-like (sclerodactylia). The condition frequently simulates Raynaud's disease in the beginning and remains localized to the hands and feet for long periods. The fingers become semiflexed, immobile, and useless, the skin over them being hard, inelastic, incompressible, and pallid. Trophic ulcerations are observed on the tips of the fingers and knuckles, which may be painful or insensitive, usually the latter. A feeling of stiffness may be the only symptom of the condition, but in some with extensive involvement, paresthesia and rheumatoid pains may be present in the extremities. The disease spreads slowly over a period of years. A diffuse involvement of the chest may lead to a cuirass-like restraint of respiration. Late in the course of the disorder hyperpigmented or depigmented spots, or a diffuse bronzing may be present, and the affected areas become hairless. Subjective symptoms are variable and mild. The course of scleroderma, however, is variable. It may involute spontaneously with no sequelae, or it may remain stationary, or progress until death occurs, usually from bronchopneumonia or some other intercurrent infection.

Morphea is a term commonly applied to circumscribed scleroderma. In this variety, the patches begin as red or bluish-red macules. This early inflammatory stage is followed by the development of yellowish or ivory-colored discrete patches or plaques, in which the skin is hard, dry, and smooth. The patches are as a rule oval or linear and arise chiefly on the chest, scalp, and face. A band-like lesion may follow the course of a rib or the longitudinal axis of an extremity or appear in the midline of the forehead. The margins of the areas are generally surrounded by a light violaceous zone or by telangiectases. Within the patch the elasticity of the skin is lost and when it is picked up between the thumb and index finger it feels rigid. The follicular orifices may be unusually prominent, leading to a condition which resembles pigskin. Such localized lesions generally progress into diffuse involvement, but they may remain stationary, or spontaneously involute, with few or no sequelae or with atrophy. Hemiatrophy of the face is associated occasionally with scleroderma in children.

The guttate variety is characterized by multiple small rounded, atrophic macules, sometimes surrounded by a purplish-blue zone. The lesions occur chiefly on the upper part of the chest and neck, and are arranged in clusters or in lines. Other regions, particularly the arms, may be involved. The spots are white, shiny, and of various sizes, ranging from 1 to 10 mm. in diameter. Due to coalescence of contiguous spots, larger scalloped patches may be formed. At times the surface of the lesions may be covered by telangiectases, scales, or by follicular dots. A narrow pink, violet, or lilac-colored line may surround some or all of the spots and in cases of long duration there may be a similar line of brownish or grayish pigmentation. "White spot disease" is a misnomer, which has been applied both to morphea guttata and to lichen planus atrophicus.

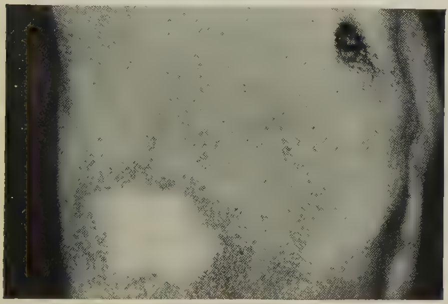

Fig. 751.—Patch of morphea on lateral chest. Note erythematous halo.

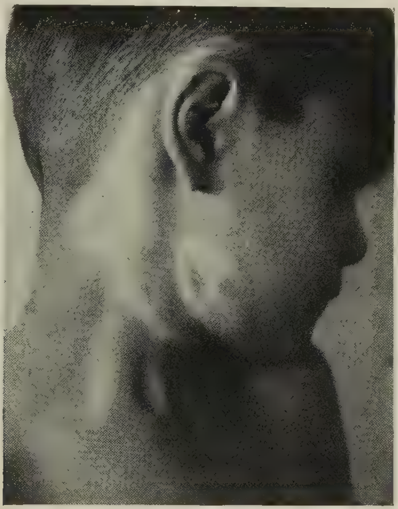

Fig. 752.—Scleroderma, band-like lesions in a child.

Pathogenesis.—The pathogenesis of scleroderma is not known. The disease is more common in women than in men and usually begins in the thirties. Some cases are associated with disturbances of the thyroid gland and Raynaud's disease, pointing to the possibility of an underlying trophoneurosis. The onset after trauma, nerve injury, infectious diseases, and toxic conditions has been recorded. The basis in some cases seems to be arsenical or lead poisoning.

Diagnosis.—The diffuse variety of scleroderma must be distinguished from Raynaud's disease and from myxedema, in which the parts are softer and not atrophic. Sclerodactylia may be confused with leprosy, syringomyelia, and Raynaud's disease. In leprosy there are generally definite sensory disturbances and other cutaneous lesions not present in scleroderma. In vitiligo the depigmentation is the sole change in the skin, other features present in scleroderma being absent. Scleroderma in the atrophic stage may so closely resemble acrodermatitis chronica atrophicans that differentiation is impossible. The subject is discussed at greater length under the latter disease. Morphea may resemble cicatrix and epithelioma, but careful examination can easily establish its identity. The guttate variety is distinguished from lichen planus atrophicus by the presence of angular papules in the latter.

Treatment.—Treatment must be directed to the underlying cause discovered after thorough study of the individual case. In all varieties it is unsatisfactory, but spontaneous recovery is not uncommon in children. Occasionally the circumscribed lesions involute during endocrine therapy; this method is therefore worth a trial. Thyroid, pituitary, and ovarian extracts are used. Radiotherapy is not recommended although reports of benefit from *x*-rays, radium, and ultraviolet light have been made. The patients I have treated have not responded to either fractional or intensive doses of any of these agents. Regular massage, warmth, and protection are advocated. Tonics containing arsenic and iodine, and cod liver oil are given. When an examination of the blood, skin or urine shows signs of arsenic or lead intoxication, treatment by sodium thiosulphate is indicated.

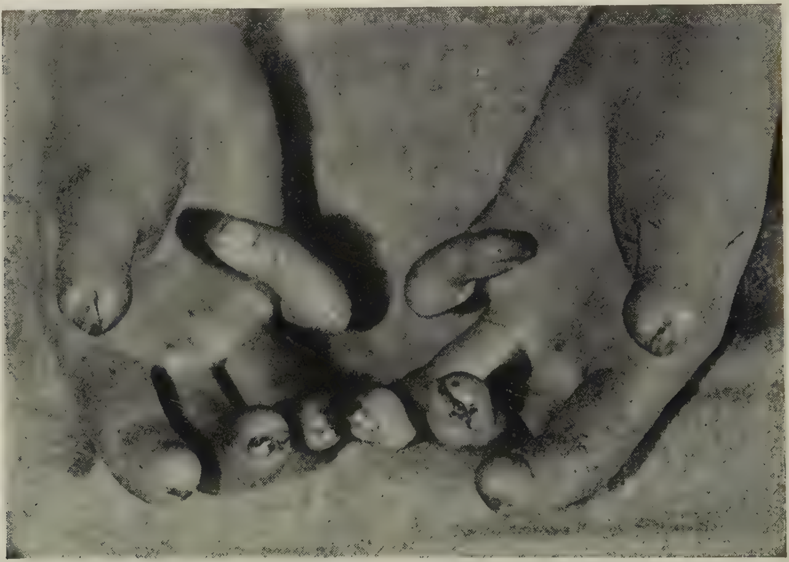

Fig. 753.—Sclerodactylia. Note trophic ulcers at tips of fingers and claw-like deformity of the hands. (Courtesy of Dr. A. M. Davidson, Winnipeg, Canada.)

RAYNAUD'S DISEASE

Synonyms.—Local syncope, local asphyxia, symmetrical gangrene.

This term is applied to a group of trophic disturbances of the fingers and toes, and sometimes of the ears and nose, which are characterized by symmetrical acrocyanosis, asphyxia, and gangrene due to vasomotor disturbance causing ischemia. The course of the disorder is progressive. The involved parts are affected in paroxysms by attacks of ischemia, which cause them to become pale, cold to the touch, and numb. In the course of time the parts fail to regain their normal circulation between the attacks and are persistently cyanotic and sometimes painful. After a while there develop superficial necroses and dry gangrene, which may cause the loss of several digits. Recurrent paroxysmal attacks of symmetrical local syncope and asphyxia serve to differentiate the disorder from erythromelalgia.

The etiology of Raynaud's disease is unknown. The local signs are probably due to spasms of the muscular coats of the blood vessels which shut off the circulation. The disorder is encountered chiefly in young or middle-aged women, and sometimes exhibits a familial tendency. Protracted exposure to cold, and mental shock are named as predisposing factors.

The treatment belongs to the field of surgery and is both local and general. Local measures should be directed to the improvement of the circulation. The application of warmth, baking, galvanism, and massage may be employed. The parts must be protected against minor forms of trauma, which may bring about infection, as the latter is easily provoked and is decidedly serious. The general treatment should be in the form of tonics, the removal of focal infection, and the treatment of anemia. Generalized ultraviolet therapy is indicated. Exposure should be avoided, as well as such vasomotor stimulants as excitement, alcohol, nicotine, or ergot.

SCLEREMA NEONATORUM

Synonyms.—Scleroderma neonatorum, sclerema of the newborn.

This is a peculiar and rare disorder of infancy in which the skin is dry and indurated. It usually develops in premature or undernourished infants and begins in the first two weeks of life, on the legs, from which areas it spreads over the lumbar regions to other parts. The skin becomes dry, livid, cold, rigid, and board-like, so that the mobility of the parts is limited and body functions are interfered with. The skin gives the impression of being half frozen and sometimes is yellowish white or has the color of wax. Nursing and even the act of opening the mouth become impossible. The temperature, pulse, and respiratory rate are below normal and there may be associated jaundice and diarrhea. The malady is slowly progressive and usually fatal. In some cases it begins later and remains localized, with eventual recovery. The treatment is constitutional, by nursing care, supplementary feeding, and ultraviolet light baths; occasionally with thyroid extract.

EDEMA NEONATORUM

Synonyms.—Edema of the newborn, sclerema edematosum.

This rare symptom-complex is encountered in premature and malnourished infants a few days after birth, beginning with drowsiness, and a pitting edema of the back, legs, and dependent parts, which may become generalized. As a rule, during one of the first three days after delivery the infant is discovered to be stuporous and the skin of the dependent parts of the trunk and extremities retains the impress of the finger. The edema may disappear at this point or it may become worse. In the latter, the skin of the limbs is livid and cyanotic; and weakness, coma, and death supervene. Other causes besides prematurity and malnutrition are syphilis, cardiac weakness, atelectasis of the lungs, and exposure to cold. The outcome is usually fatal, although early and skilful medical and nursing care directed toward improvement of the general vitality may lead to a good result.

MYXEDEMA

Synonyms.—Cretinism, hypothyroidism.

In this endocrine disease produced by functional insufficiency of the thyroid gland, there are a characteristic swelling and thickening of the skin. The surface is dry, firm, waxy, and glossy, and does not pit upon pressure. Slight furfuraceous desquamation may be present. The swelling affects chiefly the extremities and the face, which becomes puffy and expressionless. Circumscribed myxedematous swellings may occur as nodular thickenings, which are the color of normal skin or slightly erythematous, firm, and semi-translucent, or have the appearance of pigskin. There is an associated alopecia, which involves principally the scalp and outer third of the eyebrows; the hair on other parts is sparse. The temperature and basal metabolic rate are below normal. Treatment is by administration of thyroid extract, preferably by an internist.

ACROMEGALY

In acromegaly, which is an endocrine disease produced by dysfunction of the pituitary gland, changes in the soft tissues and in the bones form a characteristic syndrome. In association with the well-known objective manifestations due to gigantic hypertrophy of the chin, nose, supra-orbital ridges, hands and feet, there are a diffuse thickening of the skin and a tendency to hypertrichosis and hyperpigmentation.

HEREDITARY EDEMA OF THE LEGS (Milroy's Disease)

This is a familial condition which may occur in several generations. The lower extremities, particularly the legs, are involved, becoming large and edematous usually during adolescence. The ankles alone may be affected, but the condition is nearly always bilateral. Upon palpation the parts feel solid and there may be some pitting on pressure. The condition is persistent and may cause some discomfort.

DERMATOLYSIS

Synonyms.—Loose skin, chalazodermia, cutis laxa, pachydermatocele, cutis pendula, lax skin.

Dermatolysis is a condition in which the skin and subcutaneous tissues are hypertrophic and loosely attached, so that the skin hangs in folds. The appearance of the skin itself is unchanged, although it is somewhat coarser than normal. The neck, shoulders, face, and thighs are sites which are commonly involved. *Cutis verticis gyrata* is a similar condition in which the scalp is enlarged and loose, so that it hangs in folds at the back of the neck.

The nature of these affections is unknown, and probably some cases belong in the category of endocrine or constitutional disturbances. A few cases of congenital origin have been reported. Dermatolysis tends to be slowly progressive. Usually no treatment is necessary, but excision may be performed. The disease must be differentiated from temporary looseness of the skin after pregnancy and after the removal of large tumors, and from India rubber skin.

The designation *dermatolysis* is also applied to an entirely distinct type of disorder resembling the fibromata. In this affection pendulous connective tissue tumors (fibroma pendulum) occur, sometimes in association with loose hanging folds or pouches of skin. Fibroma molluscum gravidarum is a special type of this disorder which appears during pregnancy and disappears after labor. Under the title "diffuse and disseminate dermatolysis," described by Wise, are classed rare cases which present multiple pea-sized, rounded, soft, wrinkled, slightly raised, myxomatous swellings, principally on the back and upper arms.

INDIA RUBBER SKIN

Synonyms.—Cutis hyperelastica, elastic skin.

This unique disorder is characterized by excessive elasticity of the skin, so that it may be stretched out like a rubber band and snaps back with equal resiliency. In other respects the affected skin is apparently normal. The condition is observed more frequently in circus troupes than in any other walk of life. It tends to be localized, the elbows, neck and sides of the abdomen being the usual sites of involvement. The cause is unknown, but in some cases the disease is apparently congenital or familial.

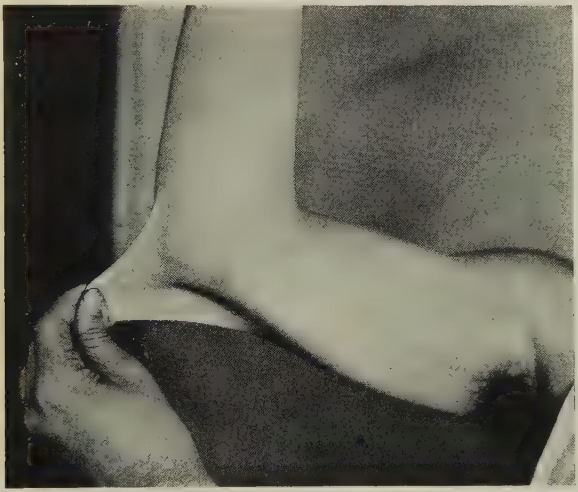

Fig. 754.—Cutis hyperelastica. (Courtesy of Dr. A. Benson Cannon.)

ATROPHIES

Synonyms.—Atrophia cutis idiopathica, atrophoderma, dermatitis atrophicans.

Atrophy of the skin is of primary or idiopathic occurrence, or results secondarily from some injury, inflammation, or nutritional disturbance. Several primary types are recognized.

Primary macular atrophy is characterized by the presence of rounded atrophic spots, about 1 cm. in diameter, generally on the upper back and sides of the chest. The lesions are smooth, slightly depressed macules covered with a thin, crinkled, glossy epidermis and are usually the color of the surrounding skin, although ivory or bluish tints are common. In the early stages the lesions instead of being depressed are elevated, due to edema, and may appear rounded or button-like, but in the late stages the palpating finger may be inserted into them without meeting any resistance on account of the degeneration of the elastic tissue. There are no sensory disturbances and no alterations in the skin between the lesions.

After macular or papular syphiloderms, atrophic spots occur which are identical with those of primary macular atrophy. It is possible that no cases of this affection are strictly primary in origin, because preceding urticarial lesions have been observed in some instances.

Schweninger and Buzzi described a peculiar type of atrophy under the title **multiple benign tumor-like new growths of the skin.** The condition manifests itself by the appearance of nummular bluish-white, slate-tinted, bladder-like lesions beneath the skin, some of which have fine telangiectases coursing over them. There are no changes clinically in the overlying epidermis. By pressure with the tip of the finger almost any one of the lesions can be inverted, so that the impinging finger slips into a hollow which offers little resistance to it, the tumor reappearing, however, like a ventral hernia, when the pressure is released. The disorder is slowly progressive, being maintained by the development of new lesions as the older ones involute spontaneously, leaving depressed soft scars. The cause is unknown and no treatment is effectual.

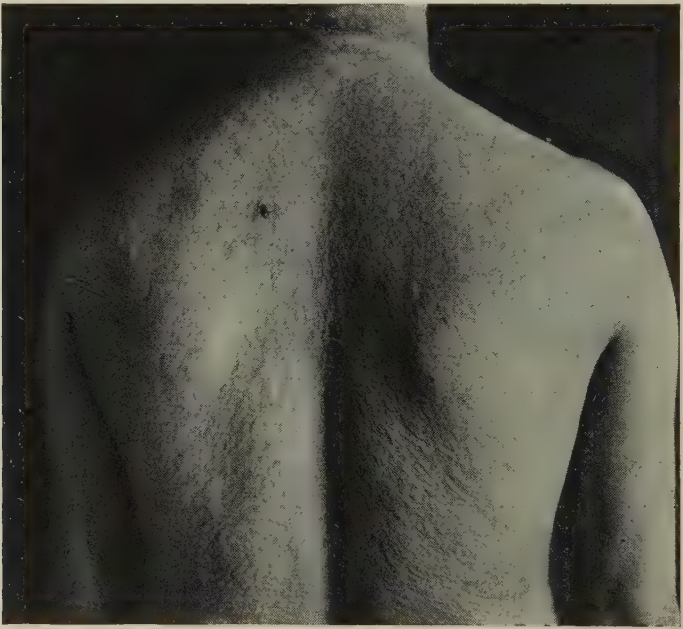

Fig. 755.—Primary macular atrophy. (Courtesy of Dr. Mihran B. Parounagian.)

Primary diffuse atrophy is better known in this country under the term *acrodermatitis chronica atrophicans.* The condition begins on the dorsa of the hands and feet and the elbows as reddish or bluish patches and gradually spreads involving the forearms and legs, and occasionally all the extremities or even the trunk. In the beginning the areas may be slightly edematous and scaly, but generally they are level with the skin and smooth. In the course of time, atrophy is manifest, and the skin loses its elasticity and pliability, becoming grayish, thin, shiny, wrinkled, stiff, and lax. When the skin is pulled away from the surface, it does not spring back into position because its elasticity is lost, which condition is called *anetodermia.* The skin in such areas is freely movable upon the underlying parts on account of atrophy of the subcutaneous tissues.

Acrodermatitis chronica atrophicans (diffuse idiopathic atrophy, atrophia cutis idiopathica progressiva) is occasionally accompanied by scleroderma and the two diseases are regarded as identical by many observers, but Wise, who has studied the subject extensively, believes they have no relationship. Ulcerations and carcinoma may supervene on the atrophic patches. The affection is slowly progressive and may remain stationary for long periods. Patches may change slightly from time to time, but complete involution never occurs. No beneficial treatment is known.

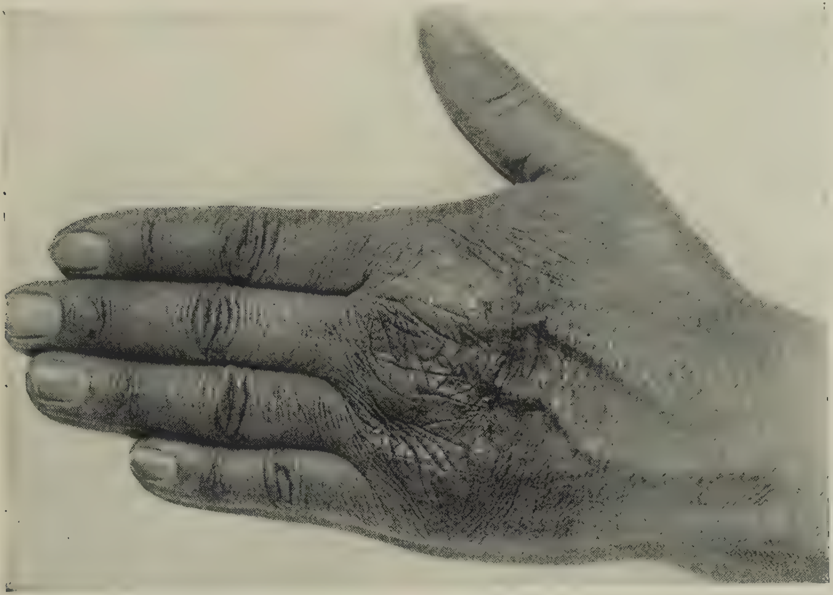

Fig. 756.—Primary diffuse atrophy (acrodermatitis chronica atrophicans); early lesion.

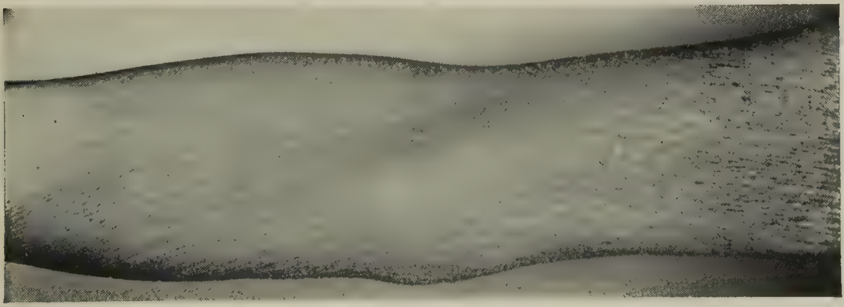

Fig. 757.—Acrodermatitis chronica atrophicans of the arm.

Hemiatrophia facialis is an atrophic process which is probably of neurotrophic origin, occurring chiefly in childhood and leading to a shrinkage of all structures on one side of the face, including the skin. The condition may make its appearance shortly after birth or may arise later after trauma or without ascertainable cause. Clinically there is a progressive reduction in size of one half of the face, and roentgenographically a proportionate shrinkage of the underlying bones. Some cases of hemiatrophia facialis are associated with scleroderma.[1]

Atrophodermia reticulata symmetrica faciei is a rare affection described by Pernet in which there is a mild erythematous and scaling condition of the cheeks which leads to superficial atrophy, so that the epidermis on close examination is crinkled and reticulated.

Atrophy of the fatty layer of the skin is also a rare condition in which there occur pea-sized or larger, irregularly rounded, bluish depressed spots. These may spread, sometimes in a linear manner, until they are several centimeters in length. The disorder has thus far been confined to the lower extremities.

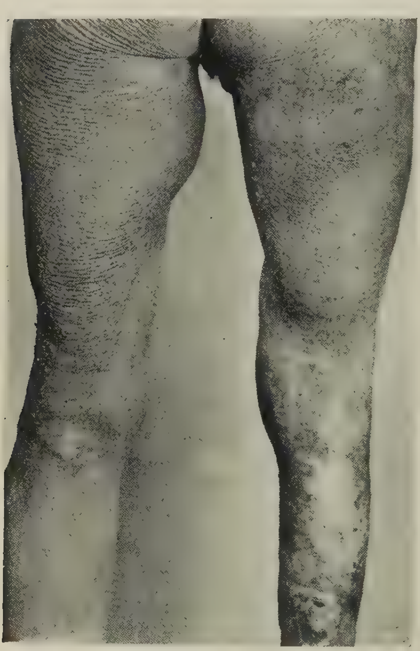

Fig. 758.—Acrodermatitis chronica atrophicans.

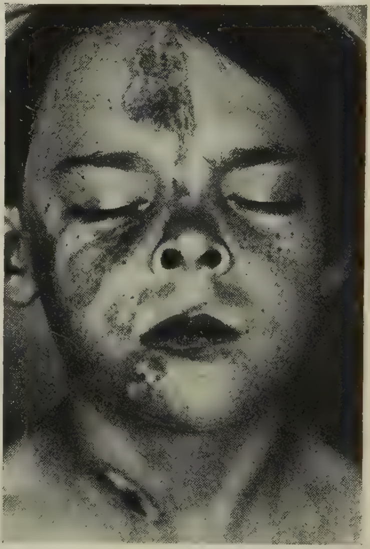

Fig. 759.—Hemiatrophia facialis in association with scleroderma of face and trunk.

Cutaneous atrophy of a secondary type may result from manifold causes. One of the common varieties is called striae atrophicae (atrophia striata et maculosa; striae et maculae distensae; striae patellares). These lesions appear as white, smooth, shiny, depressed lines or spots due to stretching of or injury to the skin. They are encountered on the abdominal wall after pregnancy (striae gravidarum); in the breasts after lactation; or in those who have been fat and reduced. Similar striae occur on the buttocks and thighs and over the knees and elbows due to rupture of elastic fibers from pressure and tension. In early striae the color may be pinkish or purplish, but in those of long standing it assumes a bluish opalescence.

Senile atrophy (atrophodermia biotriptica) is a type common in the aged. The skin becomes wrinkled, thin, glossy, lentiginous, and telangiectatic. At times there are a diffuse brownish discoloration and leathery thickening. The appendages are atrophied, so that the skin is dry and smooth, and the elasticity is diminished. Verrucous growths (senile warts) appear, especially on the face, hands, chest, and back; and eventually carcinoma may be superimposed upon some of them. Itching is a common symptom and may lead to eczematization.

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[1] Ben, F.: Hemiatrophia Faciei and Sclerodermia, Dermat. Wchnschr., 83: 1366–1371, 1926.

Atrophy of the skin may follow prolonged illness, after which it becomes dry, smooth and shiny, occasionally with branny desquamation and itching. The hair and nails may be shed.

Neuritis, paralysis, and other disturbances of the nerve supply cause atrophy of the skin, as well as of the underlying structures. The skin becomes dry, smooth, and at times hairless; there may be pigmentary disturbances, desquamation, and itching. Glossy skin (atrophodermia neuriticum) is a condition secondary to neuritis in which the skin is at first erythematous and swollen, but in the course of time develops a grayish, shiny aspect, and eventually looks like ivory. There may be associated alopecia, fissuring, or ulceration. The skin condition tends to improve after the neuritis has subsided.

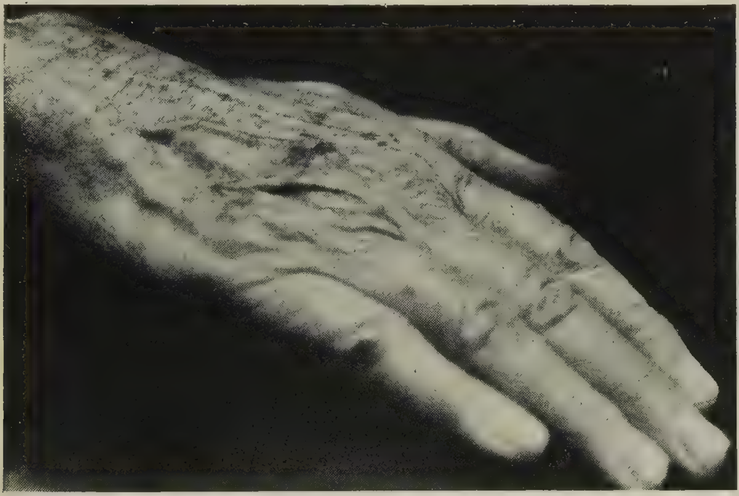

Fig. 760.—Senile atrophy of the skin. (Courtesy of Dr. Samuel T. Millard.)

Atrophy may occur as a sequela or as a manifestation of several skin diseases, especially of lupus erythematosus, scleroderma, syphilis, radiodermatitis, epithelioma, and leprosy.

Malum perforans, or **perforating ulcer,** is a chronic trophic, ulcerative affection which is seen on the extremities in debilitating diseases, particularly tabes dorsalis, leprosy, and diabetes. The primary cause of the trouble is usually located in a nerve center, and in nerve terminals where there are degenerative changes. Clinically, malum perforans begins as a circumscribed hyperkeratosis, usually on the ball of the foot. This lesion becomes soft, moist, painful, and malodorous, and later exudes a thin purulent discharge. A slough slowly develops and there is left an indolent, necrotic, painful ulcer, which lasts indefinitely and does not respond to any form of treatment. The process must be differentiated from ulcers specifically due to syphilis and tuberculosis, from suppurating corns, and from the ordinary type of diabetic gangrene.

Kraurosis vulvae is an atrophic condition of the external female genitals leading to a shriveling of the parts and leukoplakic patches on the mucosa. Graves and Smith believe that kraurosis vulvae and leukoplakia are phases of an identical process and that they are always secondary to chronic irritation either from discharges from the vagina and cervix, or from obstructed drainage, due to which normal secretions are stagnated and chemically altered, or from external sources. The condition usually occurs in persons past middle age, and is accompanied by intense local pruritus. After a time the labia, clitoris and vagina become shrunken and devitalized. The process may extend to involve the perineum and the gluteal crease. The areas grow excoriated, eczematized and nodular, and not infrequently become the site of carcinoma. Treatment is by radiotherapy and surgery. In early cases fractional doses of *x*-rays are generally effective, but in the more advanced ones even complete surgical excision of the parts is of no avail. Leukoplakic and infiltrated areas should be treated by the actual cautery.

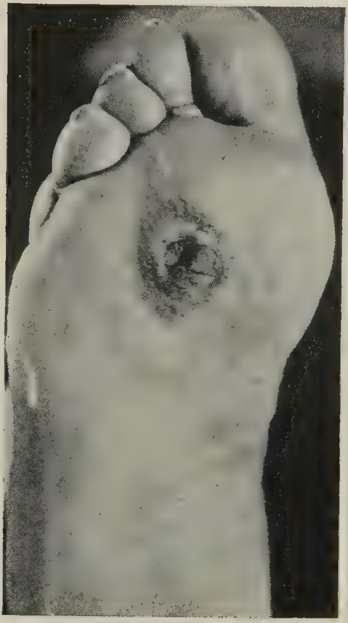

Fig. 761.—Malum perforans or perforating ulcer. (Courtesy of Dr. Mihran B. Parounagian.)

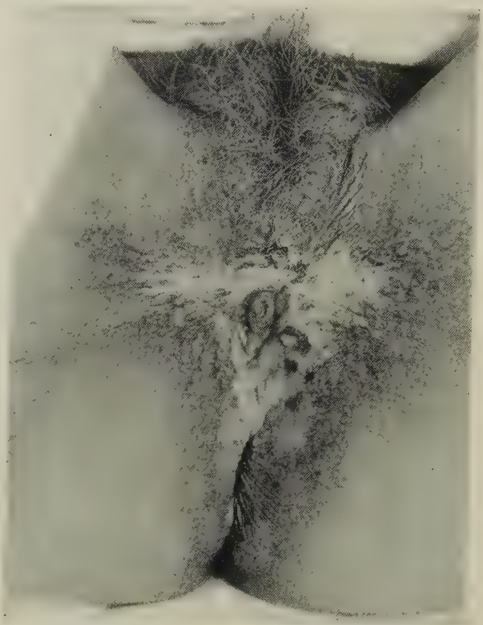

Fig. 762.—Kraurosis vulvae. Note the atrophy of the external genitals and the formation of scar tissue. The appearance resembles chronic radiodermatitis, but this patient had received no *x*-ray treatment and there were occasional hairs growing in the scar tissue

SYRINGOMYELIA

Synonym.—Morvan's disease.

This is a disease of the spinal cord which produces sensory and trophic changes in the peripheral parts, particularly in the fingers. The disease begins insidiously and gradually causes muscular weakness, hyperidrosis and sensory disturbances, especially in the thumb, index and middle fingers. The skin changes are characterized by dissociated anesthesia with loss of pain and temperature sense, and retention of tactile sense, and by atrophy and various paresthesias. Bullae and trophic ulcerations occur on the fingers and hands, and ultimately there are contractures and gangrene. Rarely other parts are affected. The disease must be differentiated chiefly from leprosy, under which caption this feature is discussed more fully.

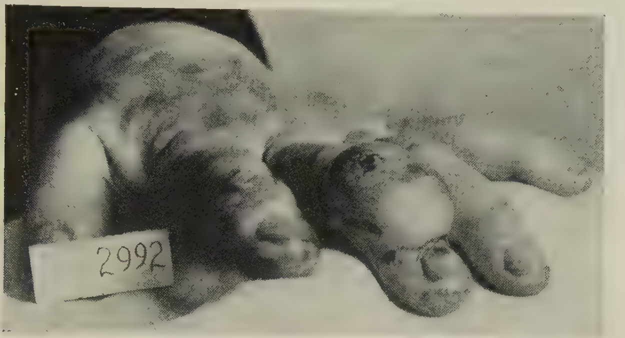

Fig. 763.—Syringomyelia, showing bulla and atrophic ulcers on hand. (Courtesy of Dr. Binford Throne.)

SICKLE-CELL ANEMIA

This condition is characterized by recurrent attacks of illness during which there are moderate pain and stiffness in the muscles and joints, occasional pain in the epigastrium or hypochondrium, weakness, fever, and general lymphadenopathy. However, the most characteristic physical sign is a greenish color of the sclerae. Dyspnea and edema of the ankles may be present, and if the anemia is marked there may be a low gastric acidity. The red cells do not usually fall below 1,500,000; the hemoglobin varies from 30 to 60 per cent; the color index is normal or very little above normal. As a rule, there is a leukocytosis and the count may reach 15,000 to 20,000, with a normal proportion of polymorphonuclears and neutrophiles. The diagnosis is made entirely upon the appearance of the red cells. In an active case the changes are found in the ordinary dried and stained blood-spread, but in latent cases the sickle cells are brought into evidence by placing a cover glass over the fresh drop of blood on a slide and sealing the edges with petrolatum. In such preparations as high as 75 to 90 per cent of the erythrocytes may take on the sickle appearance in twelve to twenty-four hours. The phenomenon is supposedly due to some alteration of the cell wall or to abnormal osmotic tension within the cell, according to Steinfield and Klauder. These authors have presented a case, described the condition in detail, and have called attention to the frequency of ulcers on the lower legs of patients affected by this variety of anemia.

Such lesions have been present in all of the reported active cases in adults and have been exceptionally seen in early childhood. Apparently the ulcers may antedate for years the cardinal symptoms of the disease, and may occur in latent cases or may appear subsequent to the development of frank clinical symptoms. Although the ulcer may appear on any part of the leg, it is most common on the ankle. The ulcers may be single or multiple, unilateral or bilateral, and are usually the size of a quarter. They are discrete, sharply marginated, round or oval, "punched-out" ulcerations with suppurating bases. Simple treatment is usually successful, and after healing there is left an atrophic, pliable, smooth, glossy, depigmented scar which is surrounded by a hyperpigmented areola.

The ulceration is not sufficiently distinctive for a diagnosis, which is only established by the constitutional symptoms and a blood examination, but the ulcer may be the chief complaint of the patient and lead to the detection of sickle-cell anemia. The disease so far has been described only in the negro race and it has been proved to be familial and hereditary, being found in both sexes and transmitted through either sex. Klauder believes the condition is not uncommon.

GANGRENE OF THE SKIN

Gangrene of the skin may be incited by a variety of causes, but there are certain disease entities which deserve special mention. *Multiple gangrene in adults* is rarely encountered in those who have suffered from severe infections and systemic disorders or from localized inflammations. Cases have been reported following typhoid fever, malaria, nephritis, and herpes zoster. Local gangrenous areas may result from pressure, as in decubitus, which is usually associated with impaired circulation. Arteriosclerosis may cause *senile gangrene*. *Syphilitic gangrene* due to endarteritis has been recorded.

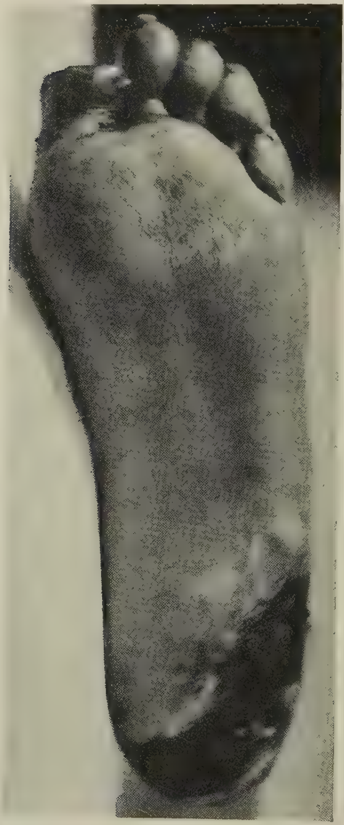

Fig. 764.—Diabetic gangrene.

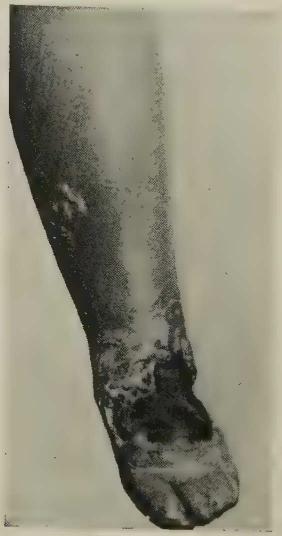

Fig. 765.—Case of hemolytic streptococcus gangrene. (Courtesy of Dr. Frank L. Meleney.)

Diabetic Gangrene.—This condition develops most often in diabetics who are past middle life, and affects chiefly the digits, although it may occur in any region. Usually there is a history of preceding trauma or local infection, and prior to the onset there may have been passive congestion, cyanosis, and numbness of the part. The gangrene develops suddenly and spreads rapidly so that extensive destruction may result. Treatment is largely directed against the essential disease, by diet and insulin. The condition of the cardiovascular system should be carefully studied and an attempt should be made to correct any defects. Locally the treatment is surgical—by antiseptic powders, wet dressings, curettage, and amputation. Secondary infection, so far as possible, should be avoided because it is frequently fatal.

Hemolytic Streptococcus Gangrene.—This is a rapidly developing condition which simulates erysipelas, but is differentiated from it by its fulminant course, the profound prostration of the patient, by the rarity of lymphangitis and lymphadenitis, and by the early appearance of bullae. Meleney frequently encountered this type of gangrene in China and reported the features which classified it as a clinical entity in 1924. Since that time he has seen 11 cases in New York. It usually appears on the extremities, particularly the lower leg, but may attack any other area, having been observed on the scalp, the face, the chest, the back, the scrotum, and penis. The onset is characterized by intense local heat, redness and swelling, by fever and extreme apathy and weakness. On the second, third, or fourth day the pathognomonic sign of the disease appears, being a dusky hue of the skin with or without bullae. The margin of the inflamed area is not raised and generally is not clearly defined. In sharp contradistinction to the treatment given in other streptococcus infections, incisions should be made as soon as the condition is diagnosed, for the process will promptly subside if the incisions are adequate, and the skin which is not yet dead will be preserved. Prompt operation makes all the difference between rapid resolution, on the one hand, and great destruction of tissue, if not metastasis, and death, on the other hand.

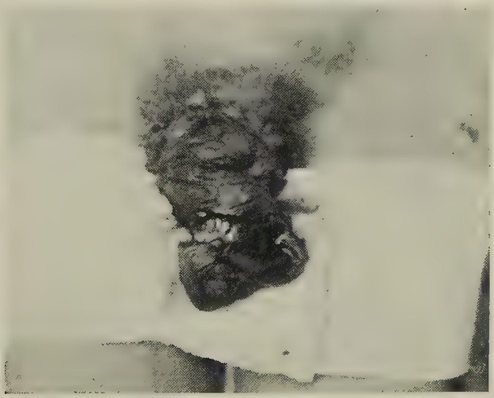

Fig. 766.—Gangrenous balanitis. (Courtesy of Dr. Edward A. Oliver.)

Phagedena.—The most common form of this condition is *gangrenous balanitis*, but other parts may be affected. Phagedenic destruction of the genitals is an occasional complication of chancre and chancroidal infections. Those who have studied the condition agree that it has no specific etiology, but is due to a combination of several distinct factors. The coexistence of chancroid, chancre, and secondary infection is the usual beginning. Untimely surgical intervention—a dorsal slit, a circumcision, or local incision and drainage—is the next step and "stands out as one striking causative factor." According to Labadie, this serves to open up new avenues for infection and aids in the implantation of saprophytic organisms deep into the hitherto uninfected tissues. Often an artificial epispadias or hypospadias ensues, the extravasation of urine over the ulcers provoking constant reinfection and chemical irritation.

Clinically, the condition is characterized by chronic painful destructive ulcers which begin on the prepuce or glans and spread by direct extension along the shaft of the penis, sometimes attacking the scrotum or pubes. The edges of the ulcer are likely to be elevated, firm, and undermined. The granulating base, which bleeds easily, is covered with a thick purulent exudate and dirty, necrotic detritus. The neighboring skin may be edematous and dusky red, and the regional lymph glands may be swollen, although this is not necessarily a marked feature. There is severe mutilation due to sloughing, without any evidence of spontaneous healing.

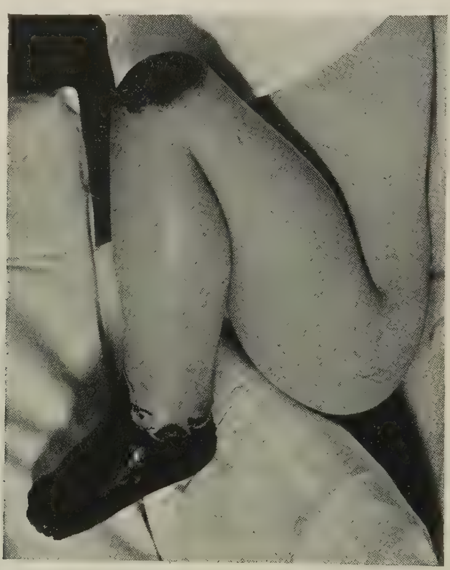

Fig. 767.—Juvenile gangrene. (Courtesy of Drs. Walton Martin and Benjamin R. Shore.)

Treatment[1] must be directed against complicating diseases such as syphilis, chancroid, and granuloma inguinale. The intravenous use of a 1 per cent solution of antimony and potassium tartrate is beneficial. In addition, energetic treatment along surgical lines must be instituted against the phagedena, as it is recalcitrant. In mild cases irrigations and wet dressings with antiseptic solutions should be tried. When a satisfactory retardation of the process does not result or when the involvement is severe, radical removal of the ulcerated area or amputation of the part by the actual cautery is necessary.

Dermatitis Gangraenosa Infantum.—(Multiple disseminated gangrene of the skin in infants, gangrenous infantile ecthyma, varicella gangraenosa, pemphigus gangraenosa, juvenile gangrene.)

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[1] Kingsbury, J., and Peck, S. M.: Treatment of Phagedenic Ulcerations of the Genitals, J. A. M. A., 87: 1900, Dec. 4, 1926.

This is a gangrenous condition which may rarely develop during the course of varicella and other exanthemata, or independently. Cases are chiefly encountered in children under three years of age, especially girls. The lesions of the exanthem become erosive and pustular and progress into deep ulcerations surrounded by an inflammatory zone. At first these are small and multiple, but gradually they become larger and confluent so that extensive sloughs occur, being worse over the lower back and buttocks. When the disorder arises independently of the exanthemata it begins with a bleb, which ruptures and produces a superficial ulceration that becomes destructive. Other lesions appear in a similar manner and lead to the formation of multiple and confluent areas of necrosis. The prognosis in all varieties is grave. Treatment is along general or medical lines, with the local use of antiseptic powders and wet dressings.

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CHAPTER XXVIII

DISEASES OF CONGENITAL ORIGIN

NEVI

Under this title is grouped a variety of circumscribed new growths of congenital origin, which may not be evident at birth, but only appear in later life. The lesions develop from both the ectoderm and mesoderm, and seem to originate from cell rests (Virchow). There is a definite vascular group due to hyperplasia of the blood or lymph vessels, and another group called "nonvascular," in which epidermal or connective tissues predominate. The lesions in the latter group may be soft or verrucous, with more or less pigmentation. Most of the nonvascular nevi contain characteristic nests of globular cells with vacuoles and occasional pigment granules called "nevus cells" and varying numbers of melanoblasts. Not infrequently nevi have a tendency to progress from one clinical type to another.

Vascular Nevi

The following types of vascular nevi are recognized:

1. Flat, nonelevated capillary nevi (nevus flammeus—port-wine stain).
2. Elevated, superficial bright red patches (strawberry marks).
3. Rounded red or purplish, superficial or subcutaneous tumors (angioma cavernosum—cavernous angioma).
4. Spider-like capillary telangiectasis (nevus araneus—telangiectasis).
5. Similar affections entirely or partially composed of lymphatics, sometimes with verrucous tendencies (lymphangioma circumscriptum, lymphangiectasis, hemolymphangioma).

The vascular nevi have striking characteristics which differentiate them sharply from the other varieties, especially in a therapeutic sense. Their transformation into malignant tumors is so exceedingly rare that this danger influences the treatment but slightly. They are composed of imperfectly formed vessels of embryonic type upon which radium and *x*-rays have a selective action, so that small doses of these agents frequently cause the complete disappearance of the nevus without injury to the normal skin. Naturally the best effects are obtained in infancy and childhood, but the utmost patience is always necessary both upon the part of the parents and of the physician. In general, radium applications should not be repeated for six to eight weeks after the preceding dose, the best results being derived from minimum dosage over a long period. Some extensive lesions require four or five years for proper treatment. In areas where cosmetic results are of minor importance, surgical diathermy or carbon dioxide snow is often substituted for radiation. In cases where previous treatment has consisted of refrigeration, iodine, or electricity, the same care must be observed in applying radium as though the part had been formerly irradiated.

Nevus Flammeus (Capillary Nevus, Port-wine Stain, Port-wine Mark).—These lesions are frequently unilateral and located on the face and neck, although they may be widespread and involve as much as one half of the body.

They are encountered chiefly in children, and may be single or multiple and range from small red macules to large red patches, which are completely blanched by diascopic pressure. They vary in color from pink to dark or bluish red. The mucous membrane of the mouth may be involved. Although the surface of nevus flammeus is usually smooth, small vascular nodular outgrowths or warty excrescences may be present. It is not uncommon for these nevi to change, as time passes, into elevated cavernous or strawberry-like patches, although, on the other hand, they sometimes become fainter or disappear, but such favorable transitions are rare. One can differentiate three types of nevus flammeus:

1. The subepidermal variety, in which the blood vessels lie under the epidermis in the subpapillary zone.
2. The dermal variety, in which the blood vessels lie principally in the midcutis.
3. The subdermal variety, in which the blood vessels lie in the subcutaneous tissues.

Very often two or more of these types are combined.

Treatment.—The cosmetic results from radium and Kromayer therapy have shown that these methods, as well as snow, have a very limited field of service. A general opinion prevails that the hazards of any form of treatment being so great it is best not to treat port-wine marks at all. Those who express such an attitude are not familiar with treatment by the air-cooled ultraviolet lamps. It is surprising how little this therapeutic means has been used for nevus flammeus, for there is an impression that compression exposures with the Kromayer lamp are necessary. There is not the slightest objection to the treatment of nevus flammeus by distance applications of ultraviolet radiation. As stated, the best results from any treatment are obtained in childhood.

Ultraviolet Radiation.—In nearly all cases some improvement can be expected from ultraviolet therapy, but only in the subepidermal variety is it usually possible to obliterate the entire lesion by this method. Such cosmetic results are most satisfactory because there is no scarring or atrophy and the skin at the site of the previous nevus is apparently normal. The response to treatment is influenced by the character of the connective tissues about the vessels and by the depth of the vascular involvement. In the other types of nevus flammeus a point is reached where the lesion becomes tolerant and after which no further improvement can be reasonably expected. At such a stage it is usually best to stop treatment entirely, for further attempts with therapeutic measures tend to produce scarring.

Although most authorities advocate compression technic with the water-cooled ultraviolet quartz light, as stated, equally, if not more, satisfactory results follow distance radiation with the air-cooled burner. Much has been written concerning the advantages of ischemia to reduce the absorption of the ultraviolet light by the blood. Although this is based upon good theoretical grounds, the practical results, in my hands, from distance radiation without compression, adrenalin or other measures to induce ischemia, have been, on the whole, better than those obtained by the compression technic. With the latter method a mottling, the shape of the quartz lens, often causes an irregular distribution of the areas of improvement; whereas an advantage of the distance radiation is that the improvement is homogeneous throughout the entire patch.

With either compression or distance therapy blistering doses are necessary. These should be given at frequent intervals, preferably while the erythema from the preceding dose is still present. Usually, treatments are applied at intervals of three weeks for a period of months. There is no danger from slight overdosage. The reaction begins with an erythema and swelling immediately or a few hours after exposure, and these increase for two or three days, and are accompanied by blistering and exudation. The process is quite painless and is followed by exfoliation which lasts for several weeks. It is best to apply no local medication to allay the reaction.

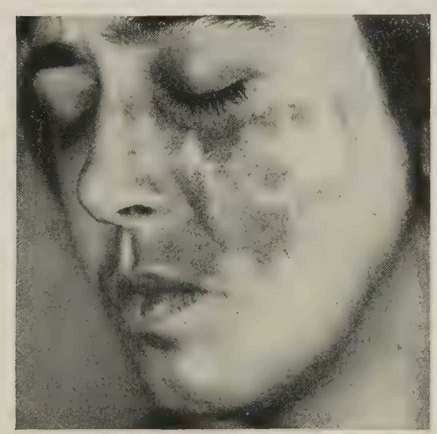
Fig. 768.—Nevus flammeus.

Good results may also be obtained by desiccation with the high-frequency current. The spark should be small and applied from a sewing needle electrode. The area to which the spark is applied is blanched by pressure with a metallic ring so that it is dehematized. In this way the capillaries which compose the nevus are thoroughly destroyed by a spark too small to produce much scarring.

Radium.—Simpson recommends flexible radium "toiles"—pieces of linen or rubber impregnated with radium sulphate. A "toile" of one-twentieth strength screened with 0.1 mm. of aluminum is applied close to the skin for a total exposure of from one to three hours. The exposure may be divided into two or more periods. In many cases, a very satisfactory result can be obtained. If a faint rose color is finally brought about, treatment is discontinued altogether for several years.

Flat glazed salt applicators, unfiltered, are also suited to the therapy of nevus flammeus. They are applied in erythema exposures as no improvement results from smaller doses. With surface applications of the standard half-strength, 10-mg. plaques, exposures for ten minutes usually suffice.

The general evaluation of radium treatment of nevus flammeus has suffered from lack of conservatism. Under any circumstance, severe scarring is inexcusable. The end-results of careful treatment, however, are by no means satisfactory, although the degree of atrophy which supervenes may be so slight as to be scarcely noticeable, and telangiectasis may be absent or inconsequential.

Carbon Dioxide Snow.—Treatment by this agent has been a favorite method. As with radium in cosmetic conditions, most of the unfavorable results have been caused by overdosage. Cryocautery should be employed frequently with very small doses, given with slight pressure for two or three seconds at approximately daily intervals. This technic leads to gradual improvement, with a minimum of scarring, although some is inevitable, and there is often a mottling which is very disfiguring. The dosage should always be kept below blistering, and it should be the aim to produce no more than repeated mild congestions. These usually appear a short time after treatment and last for twenty-four to forty-eight hours. Refrigeration is painful and in some instances is followed by keloid formation.

Other Methods.—Electrolysis and ignipuncture are occasionally employed in the treatment of nevus flammeus. They are, as a rule, unreliable and produce more unsightly keloidal scar tissue than any of the previously mentioned agents.

Strawberry Mark (Raspberry Mark, Nevus Vasculosus, Nevus Sanguineus, Angioma).—This is a variety of angioma affecting only the superficial blood vessels and having very little supporting structure. They may be present at birth or appear later as pinhead-sized or larger growths, which range in color from scarlet to purple. The lesions form raised, flat patches, sometimes broken up into smaller components between which the skin is telangiectatic. Sites of predilection are the face, shoulders, scalp and neck, but they also appear frequently in other regions. Generally they tend to grow slowly but occasionally they undergo involution spontaneously or from trauma, with conspicuous scarring, or change into mixed fibrovascular or lipomatous structures.

Treatment.—Strawberry mark is susceptible to irradiation, especially from *radium.* In general, a mixture of hard beta and gamma rays gives the best results, but in certain locations very soft rays may be preferable for special reasons, which will be considered later. The harder beta and gamma radiation exerts a more selective and less caustic action than the softer rays. It is therefore used for cosmetic reasons, to avoid atrophy and scarring. By filtration the penetration is increased, as is the likelihood of damaging deeper structures. Such injuries are avoided by keeping the dosage small. I have repeatedly caused complete obliteration of large vascular nevi on the scalp of infants without epilation, and cured lesions of the lids and orbit without ocular injury. As has been stated, treatment should be instituted early in life and exposures should always be too small to provoke an erythema or desquamation. They should be repeated at intervals of four to eight weeks.

Soft radiation may be advantageous upon small vascular nevi of the lids or mucous membranes, where the application is difficult and the exposure time is a factor. Soft rays may be obtained from unfiltered salt applicators or emanation tubes, placed in contact with the lesion—never interstitially or from a distance. Erythemas are impossible to avoid with unfiltered radium, and sequelae can be prevented only by keeping the dosage moderate. Practically all unfavorable results from the use of radium in angiomas have been due to lack of appreciation of these facts, that is, to the occurrence of overdosage and caustic radiation.

The proper intensity and quality may be obtained from flat salt applicators filtered through 0.5 mm. of silver. Half-strength glazed applicators are placed in contact with the surface of the nevus for three to four hours. When the depth of the lesion is more than 0.5 cm., distance application is preferable. Indeed, upon most angiomas a distance of 1 cm. between the radium and the lesion is advantageous. Upon a block of wood 1 cm. thick, a full-strength flat glazed applicator, filtered through 0.5 mm. of silver, should be applied for eight hours. Such a long application upon infants is often inconvenient, for which reason preference is given the stronger applicators called "trays," made from emanation tubes in a flat brass container, for which the dosage is given later.

When such applicators are not available, 0.5 mm. silver tubes applied from a distance of 3 mm. may be substituted, giving about 10 milligram hours per square centimeter. This distance is made by the usual tongue depressor upon which the tubes are affixed by collodion. In order to approximate homogeneous distribution, it is desirable to have several tubes or needles of the same strength and to partially rotate the applicator upon the lesion at intervals during the treatment.

Where the lesions are upon the external surfaces of the eyelids, they may be treated by flat applicators or tubes, depending upon their shape and dimensions. If filtration is employed, the cosmetic results are best, but its use necessitates more thorough protection of the eyeball. This can only be accomplished by inserting between the eyelid and eyeball a protective screen made of lead or brass covered with sufficient paraffin to absorb the secondary radiation. This screen is oval and convex, and slightly larger than the palpebral fissure. The conjunctiva is anesthetized by 2 per cent holocaine, a few drops of mineral oil are inserted, and the screen is then placed between the eyeball and the eyelid. In small children this technic is usually impossible and short exposures (50 to 100 mc. min. per sq. cm.) of unfiltered radiation are more practicable.

Not infrequently strawberry marks occur upon the edges of the eyelids. In this location the lesions are most favorably treated by radium tubes, filtered only through glass; because with soft radiation in small doses, the chances of producing epilation are slight and the duration of the exposure is only a few minutes. With the use of soft radiation upon the eyelid, sufficient protection is afforded the eye by shielding with lead-foil about the lesion, the lid being kept closed and the lesion retracted as far as possible from the eyeball. The radon tube is attached to a tongue depressor so that it projects beyond the end and it is held against the lesion for about 1 millicurie hour (60 mc. for one minute). The dose of 1 millicurie hour with a glass tube is insufficient to produce epilation. Usually two or three treatments given at monthly intervals suffice to cause the disappearance of small vascular nevi upon the edges of the eyelids.

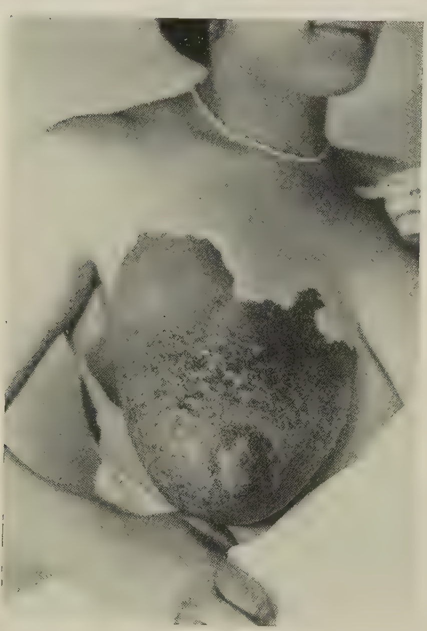

Fig. 769.—Strawberry mark.

Although strawberry mark can be cured by other means than radium therapy, such methods are so liable to produce scarring that they should not be employed except upon inconspicuous areas and where facilities do not permit radium therapy. The use of *electrodesiccation* in this particular type of angioma offers some advantages. The lesion may be destroyed instantly without loss of blood, and healing takes place in three or four weeks with complete eradication of the nevus.

Infants may be treated during the first few days after birth without anesthesia. The proper technic requires a small current. The skin is approached by the electrode, but not touched. It is important to start the destruction at the center of the lesion, the tissue shrinking up and forcing the blood out ahead of the application. Then in a concentric manner the edges are reached and destroyed. After the superficial portion has been thus treated, the current must be thoroughly applied to the base. Keloids sometimes follow desiccation if too heavy a current is used.

Carbon dioxide snow and *cauterization* are also at times efficient methods of treatment. The technic of refrigeration therapy is described on page 632, and all of the conservatism in dosage admonished there applies also to the treatment of strawberry mark. These methods are painful and may cause excessive or keloidal scarring.

Soft roentgen radiation may be effective but the results are not as satisfactory as those of the measures already discussed. The x-rays may be produced by an ordinary dermatological therapeutic apparatus with a 3-inch spark gap. Occasionally lesions are encountered which respond only partially to x-ray therapy, or they reach a point where very little further improvement is evident. The tendency in such cases is to increase the x-ray dosage with the inevitable production of an erythema, which later leaves atrophy and telangiectasis. This error is to be carefully avoided. The w-rays should not be used in the treatment of this type of nevus as intensive doses are necessary and are likely to be followed by sequelae.

Angioma Cavernosum (Cavernous Angioma).—This type of vascular nevus is the raised angioma which is observed mainly in infants, being present at birth or appearing shortly afterward. It is usually rounded or flat, bright red or deep purple, and spongy; but when it persists into adult life this consistency may be varied by the admixture of fibrous connective tissue. The lesions occur chiefly upon the head and neck, but are found as well in other regions. They may be nodular, lobulated, polypoid, or flat elevations. The cutaneous variety involves the superficial integument and is elevated above the level of the surface. There may be a covering of the mass by thinned derma, or the tumor may be so superficial that no grossly visible skin overlies it. When deep structures are involved the subcutaneous or submucous portion may be larger than the cutaneous lesion. The subcutaneous variety simulates many other conditions, from which it is to be differentiated by fluctuation and, at times, by pulsation. The skin over it may be normal or the site of a vascular nevus. The angioma may be made up of many small vessels, which feel like a bunch of worms, or it may be composed of a few large sinuses. In the latter instance, the tumor rapidly disappears on compression. Frequently the mass consists of a mixture of imperfectly formed arterial, venous, and lymphatic elements.

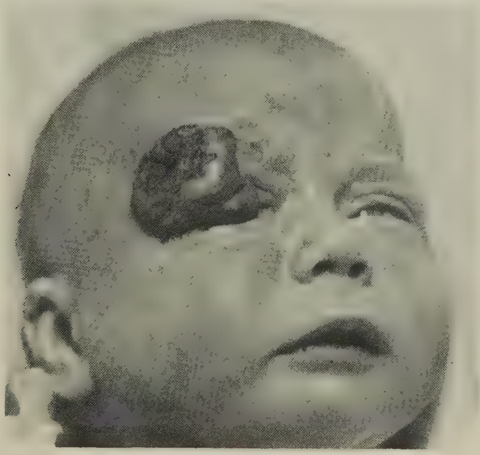

Fig. 770.—Hemangioma cavernosum.

Occasionally a capillary nevus or strawberry mark may affect the surface over a cavernous angioma, and, more rarely, pigmented or verrucous changes are associated with it, so that it is a mixed type of nevus. The amount of fibrous tissue present in these nevi is variable. In lesions which have undergone trauma, especially with subsequent hemorrhage or ulceration, the connective tissue may be increased. Spontaneous involution of nevi of this type is not infrequent, but it is usually incomplete and accompanied by more scar formation than would result from proper therapy.

Principles of Radium Treatment.—Remarkable results are achieved by radium in the treatment of cavernous angioma, there being a selective action upon the blood vessels comprising the nevus. The only poor effects from this therapy have been from excessive dosage. With this in mind, the operator should keep the dosage exceedingly small, and should give treatments infrequently so that there is a very gradual involution and disappearance of the lesion. The radium dosage should always be below the amount which produces a skin reaction. The lesions should be carefully watched between treatments, and the dose should not be repeated while any improvement is occurring, or while there are other reactive changes in the normal skin or in the lesion. In the skin such changes may be a vascular irritability or epilation, and in the lesion there may be swelling, tenderness, or active regression.

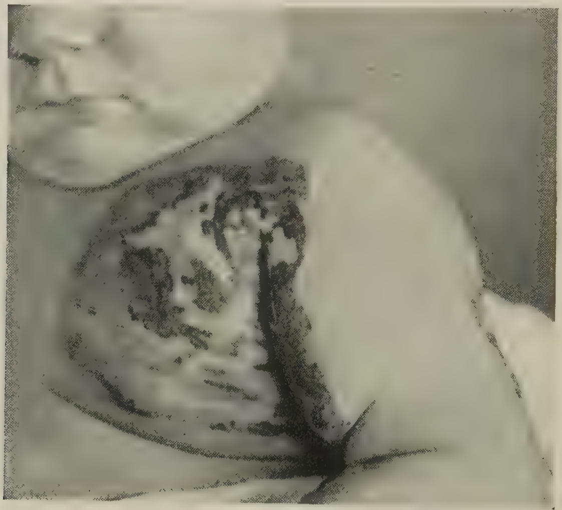

Fig. 771.—Spontaneous cicatrization of hemangioma.

As a rule, treatments are repeated at intervals of not less than four weeks. Routine repetition at intervals of eight weeks is generally safe, but in lesions which have been treated extensively with gamma radiation, lapses of several months between exposures may be desirable. The size and depth of the lesion determine the number of treatments to be given. They should be instituted, if possible, in infancy or in childhood, for in later life the lesions may be so resistant that complete obliteration cannot be secured without slight atrophy and telangiectasia.

Two methods of radium application are of outstanding importance, the gamma rays being utilized in both: (1) External treatment with flat brass applicators at a distance, and (2) interstitial use of removable platinum implants.

(1) *External Radium Treatment.*—For most lesions a distance of 1 cm. between the skin and the radium applicator increases the effectiveness of the treatment. This distance may be extended to 2.5 cm. with benefit whenever the nevus is unusually thick or deep. Distance radiation requires a larger quantity of radium and generally longer exposures, but these disadvantages

are fully offset by the benefits gained from adequate dosage at the depths of the lesion coincident with minimum surface absorption.

Proper approximation is imperative to give an even distribution to the dosage. The use of plastic substances for moulds is recommended when difficulties are encountered in the treatment of infants or nervous children. Many ingenious devices can be used. At times, a plaster cast about the part is the only effective method of producing immobility and accurate approximation of the radium. When distance is desired, the plaster may be used for this purpose or blocks of wood of proper thickness may be affixed to it. It is suggested that before the application of the radium the outline of the lesion be traced on the plaster and subdivided into square centimeters, which will aid in the further estimation of dosage.

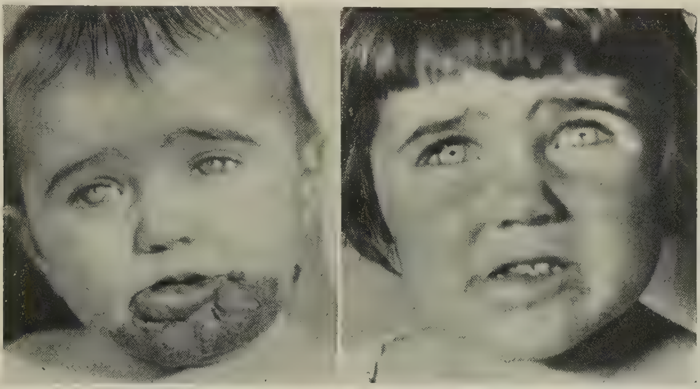

Fig. 772. Fig. 773.

Figs. 772, 773.—Hemangioma of lower lip and chin. Before and after treatment by radium.

Applicators and Dosage.—For general use upon cutaneous cavernous angiomas the flat trays containing emanation tubes are recommended. The tubes are placed in slots in the metal tray and arranged so that the radiation is evenly distributed over the surface of the applicator. The filtration should be 2 mm. of brass or an equivalent, and 2 mm. rubber. The gamma rays emitted are best suited for the selective effects desired upon the vessels. The applicator is placed upon a block of wood or cork at a distance of 1 cm. from the surface of the lesion. Shielding is advisable only when very small nevi are under treatment, for whenever possible the applicator should be only slightly larger than the nevus. For angiomas in infants the following table of dosage for these gamma-ray trays is suggested:

Applicator size, cm.	Distance of application, cm.	Dose, millicurie hours.
Square, 2 x 2	1	100
Circle, 4 diam.	1	200
Rectangle, 4 x 5	3	800
“ 2.5 x 1.7	1	125

Dosage is necessarily subject to many influences. In the treatment of infants, with trays at 1 cm. distance and less than 4 sq. cm. surface area, it is customary to use between 25 and 40 millicurie hours per square centimeter. Upon adults, the dosage may be slightly larger.

When emanation trays are not available, flat glazed salt applicators (plaques) may be substituted for them. The usefulness of either form of applicator depends entirely upon its strength. The salt applicators should be double strength whenever possible and at least full strength, as weaker preparations are too time-consuming for accurate use upon infants. Double-strength flat plaques, filtered through 0.5 mm. of silver, may be placed at a distance of 1 cm. for four to five hours. The treatment is preferably divided into two or three sittings.

Small lesions may be adequately irradiated by 0.5 mm. silver tube applied at a distance of 1 cm. upon a block of wood, with a dose of 40 milligram hours or by a 2 mm. silver tube at the same distance for 150 milligram hours. Tubes placed at a distance may be used also for the treatment of extensive lesions. In such cases the distance is increased and the dosage is relatively reduced on account of the overlapping. The lesion is divided into squares 1 inch in width. Over each square a 0.5 mm. silver tube is placed at a distance of 2.5 cm. for 75 to 100 milligram hours. These exposures are of such long duration that a splint or plaster-of-Paris cast should be used to insure immobility of the part during the exposure.

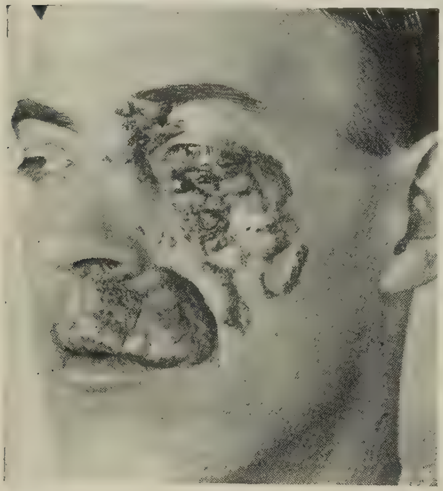

Fig. 774.

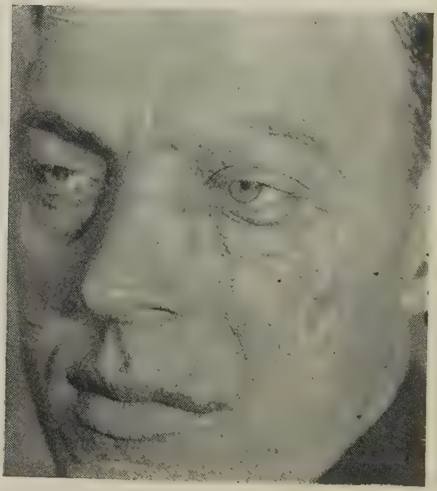

Fig. 775.

Figs. 774, 775.—Nevus vasculosus in an adult. Before and after treatment by radium. Both external radiation from gamma-ray trays and interstitial radiation from platinum removable seeds were used in this case.

Although distance radiation is preferable for a perfect result, it is not essential for the treatment of fairly superficial vascular nevi. This is especially true in locations which are inconspicuous. Contact doses of flat glazed salt applicators have been popularly used for cutaneous angiomas and excellent results have been derived from them. Glazed half-strength plaques, screened with 2 mm. of brass, may be applied in close contact with the lesion for a total exposure of eight to ten hours, or with 0.5 mm. silver for three or four hours, brass being preferable. The exposure may be divided into two or more periods. Contact applications may be occasionally substituted for distance methods upon large lesions by dividing the tumor into areas slightly larger than the flat applicators and applying them filtered to these areas with the avoidance of overlapping. Upon rounded lesions the slight cross-firing obtained by such technic is frequently sufficient to be of some value.

When both the inner and outer surfaces of the cheeks are involved, flat applicators applied externally in suberythema filtered doses are made to cross-fire with radium employed from the buccal aspect either from the same form of applicator or from element needles inserted into the growth. Cross-firing in certain locations gives better cosmetic results than large doses from one heavily filtered applicator applied at a distance.

(2) *Interstitial Radiation.*—Removable platinum implants give results in the treatment of angioma cavernosum which equal or surpass those obtained by external gamma radiation from a distance. The implants are inserted obliquely into it through the healthy skin beyond the edge of the lesion. Removable platinum implants (3 mc.) are placed 2 cm. equidistant from one another, about 1 cm. deep and are withdrawn in two to three days. Preference for removable platinum implants or permanent gold implants depends upon the location of the lesion and the amount of infection. Removable platinum implants should be chosen for all lesions which are easily accessible and not infected. In angiomas there are less bleeding and less chance of infection if permanent gold implants are used but more tendency to later fibrosis and to incomplete eradication because the radiation from them is less penetrating than from platinum implants. In the treatment of angiomas already infected, crusted or bleeding, or those within the mouth or vagina, the smaller and unthreaded gold implants are preferred. Dosages for gold implants in the treatment of vascular nevi range from 0.8 to 1.2 mc. per implant, one being inserted in each cubic centimeter.

Modifications of Treatment in Some Varieties.—In deep, subcutaneous and submucous nevi, distance and interstitial methods are used. The former is preferable where the lesion is subject to infection, and the latter when it is covered by devitalized integument or has proved tolerant to reasonable distance dosage. Distance applications in the form of packs (5 x 5 cm.) may be as much as 500 mc., screened by the equivalent of 2 mm. of brass, for an exposure of two or three hours at a distance of 3 cm. The exact details of dosage will vary with each case, but, in general, one should employ the doses given in the Radium chapter (page 195).

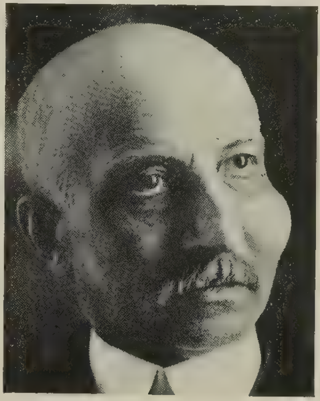

Fig. 776. –Subcutaneous angioma. (Courtesy of Dr. Nathan T. Beers.)

Radium needles are especially useful in the treatment of angiomas of the tongue, buccal mucosa, and vagina, where the lesions are apt to be large and deep, but their use in these locations is not without an element of danger of infection. Five to 10 mg. steel needles may be used, the former on small lesions and the latter on more extensive ones. Depending upon the size of the lesion and the number of needles introduced, the dosage will vary from 25 to 50 milligram hours per needle. Removable platinum or gold implants permit a more even distribution of dosage than the larger needles. In all instances, the implants should be introduced through the normal skin or mucosa, and when distance radiation is used upon subcutaneous angiomas that are surmounted by capillary nevi or strawberry patches, great care should be exercised to give the dosage to the subcutaneous portion largely through areas of normal skin, as the skin affected by the superficial nevus is prone to atrophy or ulceration and should be considered more delicate than the normal skin. If possible, it is best to treat the subcutaneous portion entirely by cross-firing from areas on the normal skin or by needles inserted through it, and, after healing has occurred, to give treatment required for the superficial nevus separately.

Special consideration must be given an angioma within the orbital cavity. This involvement may be a part of an extensive skin nevus or strictly localized. In either event, there may be associated with it exophthalmos, impaired vision, congenital or secondary glaucoma, or pulsation of the eyeball. The danger of additional damage to the visual apparatus or skin about the eyes from improper radium treatment is real and calls for extreme caution in dosage and frequency of exposures. Distance and heavy screening are desirable. I have found a flat applicator of 3 sq. cm. surface area adapted to use upon infants practicable in most cases of orbital nevi. It should be applied at 1 cm. distance, screened through 2 mm. of brass or its equivalent, for a dose of 100 to 150 millicurie hours at intervals of eight to ten weeks. The radiation should be directed through the outer wall of the orbit perpendicular to its long axis, the block being placed upon the skin about 1 cm. posterior at the outer canthus. In some cases, platinum or gold implants have special advantages, either alone or combined with external radiation.

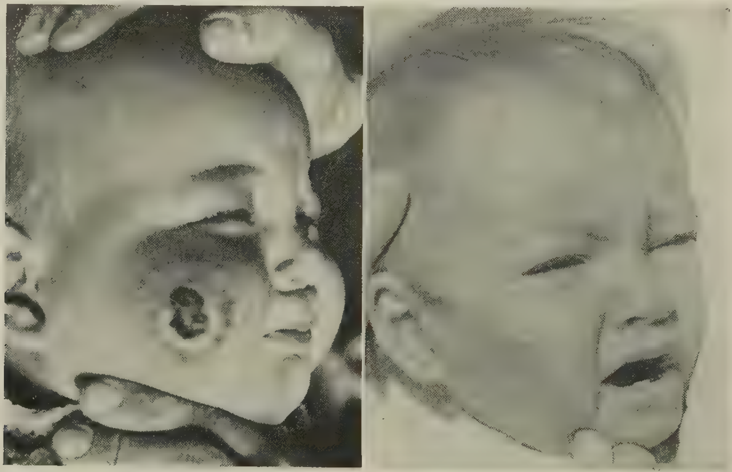

Fig. 777. Fig. 778.

Figs. 777, 778.—Hemangioma cavernosum. Before and after treatment by gold radon implants. This case had been previously treated by carbon dioxide snow, which caused the ulcer and made some scarring inevitable.

Indications for Different Forms of Radium.—(*a*) Brass *trays* containing silver tubes (see page 195) should be used at a distance on practically all lesions. There are certain exceptions in which removable platinum implants or platinum needles are preferable, but, on the whole, there is no better form of treatment for cavernous angiomas than distance treatment with gamma-ray trays.

(*b*) Interstitial use of *removable platinum or gold implants* is the method of choice in the case of bulky angiomas in all locations, but especially those deep beneath the skin or on the mucous surfaces. The bleeding produced by such treatment tends to be less than that caused by needles. The gold implants produce more fibrosis than needles or removable platinum implants.

(*c*) *Flat salt applicators* are suitable for the majority of small angiomas. Plaques of round shape are preferable to square ones for this work. Filtration with ½ mm. of silver, 1/10 mm. of lead, or 1 mm. of brass is desirable. In many small superficial lesions direct skin application is sufficient.

(*d*) One half millimeter silver *tubes* have not the extensive usefulness of flat applicators but can be satisfactorily employed for the treatment of most types of angiomas and are especially adapted to those which involve the nostrils, tips of the fingers, aural canals, and eyelids. For such purposes contact applications suffice, the tube being held in place either by the operator or by collodion. In the former instance, it is clasped securely in a long pair of artery clamps.

The treatment of fairly large and thick angiomas by silver tubes applied from a distance may be carried on satisfactorily by those who are skilful and careful in methods directed at changing the essentially focal nature of radiation from a tube into a more diffuse and equally distributed form. A substitute for a flat applicator may be made by placing a tube on a block of wood at a distance from the lesion and rotating it so that the dosage is equally distributed over the sectors of the circular area under treatment. For distance treatments satisfactory flat applicators are readily made from tubes (see page 184). Such applicators may be used directly in contact with the skin, but the more the filtration and distance are decreased, the more pronounced are the focal characteristics of the radiation from these multiple sources.

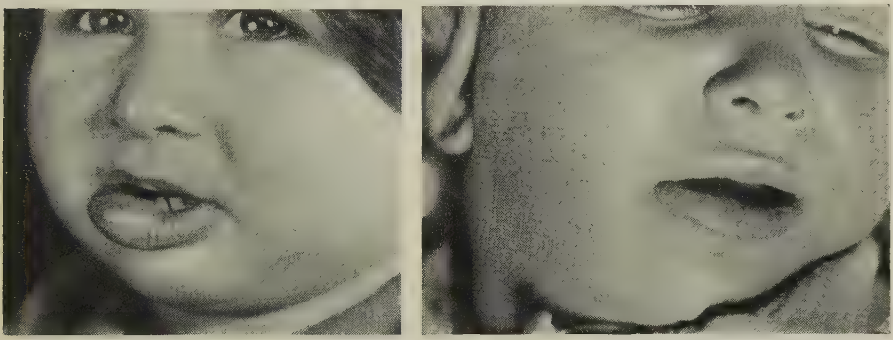

Fig. 779. Fig. 780.

Figs. 779, 780.—Hemangioma of the lip. Before and after radium treatment. A plaque with a filter of 0.5 mm. silver was used at a distance of 1 cm.

(*e*) Radium *needles* are especially useful in large angiomas of the mucous membranes, being inserted through the unaffected mucosa outside of the lesion. The danger of hemorrhage is slight, as the needle acts as a barrier to the escape of blood and clotting occurs before the needle is removed. After withdrawal, there is sometimes a little oozing, but this is inconsequential. Radium needles may be made into tubes and flat applicators suitable for external radiation, as previously described.

(*f*) The pronounced beta-ray effect of *bare seeds* is highly caustic and produces focal necrosis about each implant. Such treatment is not selective; it is invariably followed by intense fibrosis and is only mentioned to be condemned.

Indications for Other Methods of Treatment.—Surgical excision is generally practised only on small and accessible lesions when cosmetic results are a minor consideration, or some doubt is entertained as to the diagnosis. Refrigeration, ignipuncture, electrocoagulation, and other purely destructive methods of treatment are justifiable only in the very fibrous radioresistant lesion, exceptionally encountered in adults, and in inconspicuous lesions where cosmetic results are less important than the trouble, time, and expense of radium therapy.

Nevus Araneus (*Spider-like Nevus, Telangiectasia, Stellar Nevus*).—These small telangiectases are best treated by *electrolysis*. The outfit is the same as that described under the treatment of hypertrichosis. The needle is connected with the negative pole of the galvanic current and is inserted into the lumen of the affected vessel. Very often at the center of the spider nevus there is a vascular punctum from which the smaller vessels radiate. Destruction of this central point may eradicate the entire lesion. From $\frac{1}{2}$ to 1 ma. of current is passed through the needle for one or two minutes. During treatment slight local edema occurs, and this causes compression which is sufficient to obliterate some of the smaller vessels. Their disappearance causes the lesion to become temporarily invisible before all of its parts are destroyed by electrolysis. After a few days the remnants again become visible and repeated treatments are necessary to cause permanent eradication. There is some danger of scarring, which is best avoided by the use of a small amount of current and a very fine needle, and by not attempting too much at any one sitting. Often, three or four treatments are required to cure one of these tiny lesions without scarring.

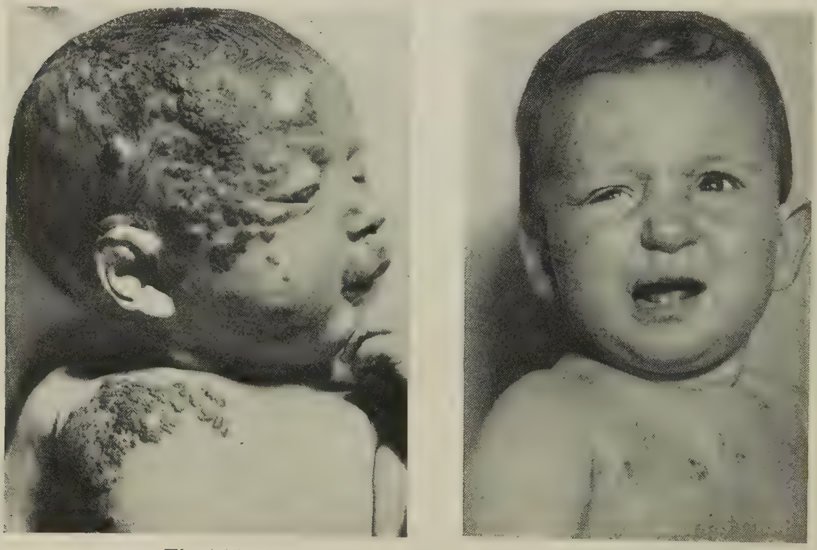

Fig. 781. Fig. 782.

Figs. 781, 782.—Extensive hemangioma. Before and after radium treatment by gamma-ray applicators used at a distance of 1 cm. Note the involvement of the scalp, ear, upper lip, and lower cheek, and the bulging of the right pectoral region due to a subcutaneous mass.

Cauterization is a simple method which may be justifiably substituted for electrolysis, although it possesses less fineness of control.

Radiation exerts very little action upon most of these spider nevi. Rarely an excellent result is obtained by the beta rays of radium in a small dose just sufficient to cause a skin reaction. Repetition of such reactions or the giving of larger doses is unwarranted because of the inevitable atrophy or scarring which follows.

Lymphatic Nevi.—(*a*) *Hemolymphangioma.*—This is a combination of telangiectatic blood and lymph elements, which is usually radiosensitive and amenable to the technic described for hemangioma. These lesions hold an intermediate position between hemangiomas and lymphangiomas in regard to their response to radiotherapy, as well as in the make-up of their constituent parts.

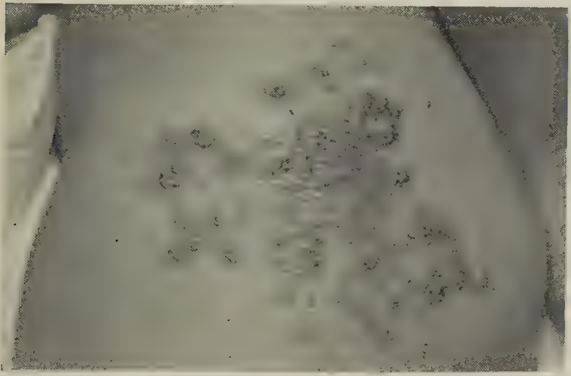

Fig. 783.—Lymphangioma circumscriptum. (Courtesy of Dr. Benjamin F. Ochs.)

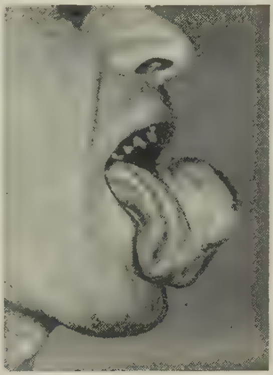

Fig. 784.—Submucous lymphangioma of the tongue.

(*b*) *Lymphangioma circumscriptum* (lymphangioma cavernosum, lymphangioma simplex, lymphangiectodes).—This form of nevus is characterized by groups of deep-seated vesicles due to a dilated and cystic condition of the lymphatic vessels. A resemblance to frog-spawn has been noted. The lesions are usually of a yellowish straw color, but occasionally are reddish or purplish because of the mingling of small blood vessels. When they are punctured, a clear colorless fluid exudes. The nevi are arranged irregularly in groups that may be distinct or connected by sparsely scattered lymph cysts,

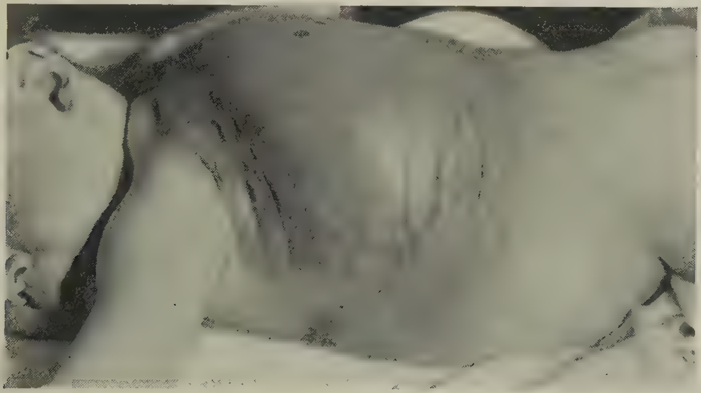

Fig. 785.—Extensive mixed type of nevus composed largely of lymphatic elements. (Courtesy of Dr. A. Benson Cannon.)

the entire process, however, being as a rule localized to one region. The sites of predilection are the thighs, upper arms, axillae, and the mucous membrane of the mouth, particularly the tongue. At times the surface is verrucous, in which instance the color may be brownish, and the lesions may be mistaken for warts. In the course of time, such nevi show slight changes, owing to the disappearance of individual vesicles, either as a result of trauma or spontaneous rupture, and the development of new vesicles. When subcutaneous they form small rounded, compressible, circumscribed tumors, over which the skin may be of normal color, or of a pinkish or yellowish hue, and sometimes telangiectatic.

Radiation has little selective action upon these lesions, although several cures have been reported. Caustic exposures are generally necessary. Usually better results may be obtained by electrocoagulation, the actual cautery, carbon dioxide snow, or excision. The choice between these methods depends upon the size and the location of the lesion, surgical diathermy having preference in extremely vascular parts such as the tongue, buccal mucosa, and vagina.

(c) *Angioma Serpiginosum.*—This rare type of vascular nevus spreads outward from an original angioma or ectatic vessel in the form of numerous telangiectases which eventually fuse to produce larger patches, while new telangiectases appear at the edges. Intensive exposures of ultraviolet radiation have been reported as beneficial.[1]

NONVASCULAR NEVI

There is no uniform method of treatment for nonvascular nevi, as at present it is disputed which of them may develop into malignant tumors and which, if any, are free from that danger. Thorough removal is always desirable. For lesions considered dangerous, this is best accomplished by

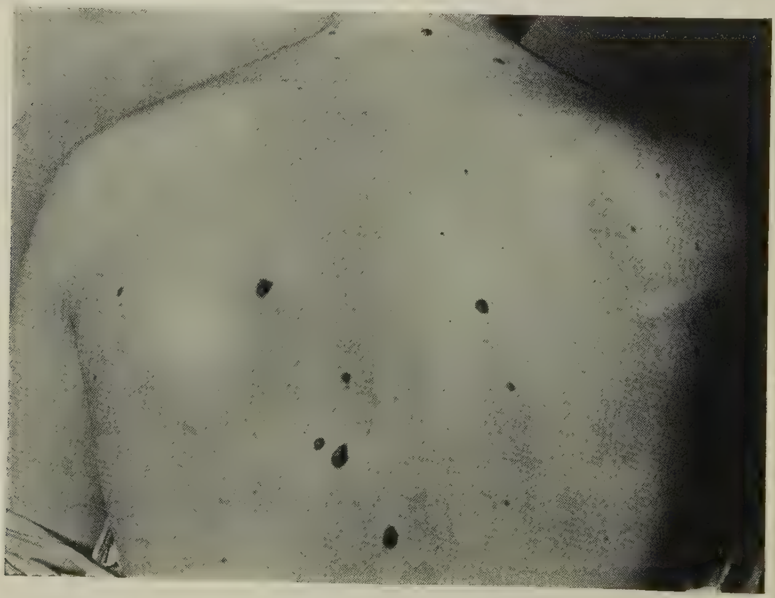

Fig. 786.—Pigmented moles.

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[1] Wise, F.: Angioma Serpiginosum (Infective Angioma of Hutchinson), with a Report of a Very Extensive Case, Tr. Sect. Dermat. and Syphilol., A. M. A., 1913, pp. 177–203.

wide surgical excision or by the electrical cutting current. However, even upon this point there is a difference of opinion; some firmly believe in preliminary destruction with massive doses of radium before operative removal. A combination of surgical removal followed by radium treatment is also advocated. The suggestion *per se* admits the incompetency of at least one of the methods, for if the lesion is completely removed by surgery, why should any further treatment by radium or other measures be necessary?

It is true that numberless moles are treated most crudely by tying threads around them, by caustics, electrolysis, and other procedures, used by the laity and beauty parlors, not to mention the medical profession. The majority of these cases do not develop neoplasms. It is only the very occasional case in which difficulty is experienced. Dermatologists treat certain types of moles without fear of subsequent dangers, whereas pathologists maintain that all moles are potentially dangerous. There may be reasons for this skepticism; but, as a matter of fact, the pathologists observe the end-results and are not likely to have accurate records concerning the clinical appearances of the moles in the quiescent state before they become neoplastic. Some surgeons advocate excision of all pigmented moles lest they become malignant, but the term has such a loose application that such statements can be variously interpreted. The clinical experience of many dermatologists has been that certain types of soft moles are practically innocuous and that other types are highly dangerous.

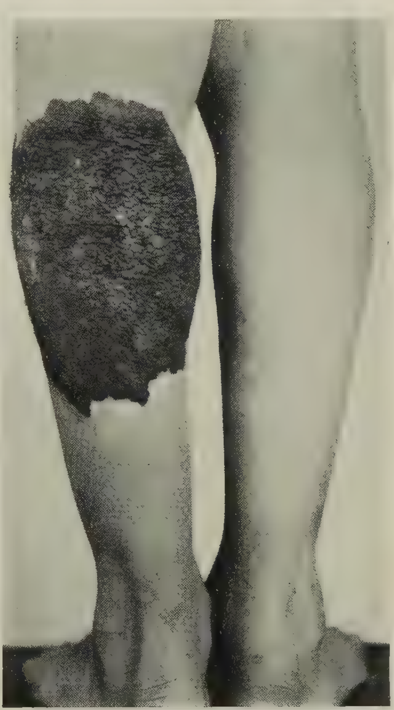

Fig. 787.—Large pigmented and hairy mole.

From the standpoint of treatment the common nonvascular nevi may be differentiated into the following groups:

1. Pigmented macules and patches (nevus spilus).
2. Soft moles (nevus pigmentosus, nevus pilosus, nevus sebaceus, nevus papillomatosus, *et cetera*) of the following kinds:
    - (*a*) Fleshy, pedunculated soft moles.
    - (*b*) Small soft hairy moles.
    - (*c*) Black, bluish-black, or brownish-black, flat or rounded moles, usually hairless.
    - (*d*) Extensive, brownish, usually hairy, moles (including regional and "bathing-suit varieties").
    - (*e*) Lobulated and fatty nevi.
    - (*f*) Mixed types.
3. Hard and verrucous nevi (nevus verrucosus).
    - (*a*) Linear nevi, including systematized nevi.
    - (*b*) Congenital warts.

Theoretically it is presumed that melanocarcinoma may originate in any mole containing nevus cells, but practically most instances of this growth arise from moles which are deeply pigmented—*black, bluish black,* or *brownish black*—and either flat or slightly elevated. For some reason the latter demand special consideration, and treatment more drastic than that given the other varieties. There are several other clinical types of pigmented nevi, and whereas all of them apparently have a common origin, variations in suitable treatment are caused by differences in the hazards associated with them from a clinical point of view and by a desire to obtain the best cosmetic results consistent with safety.

The significant signs in a mole that is undergoing malignant change are increased vascularity and pigmentation, crusting or superficial ulceration with periods of bleeding or tenderness, a palpably firm increase in bulk of the lesion, or the development of one or more nodular thickenings, just within or a little outside of its periphery. As Dawson warns, the history of trauma or mechanical irritation, which is usually obtained in such cases, should not be lightly considered. "Such history and signs justify wide extirpation, and a microscopic study of the tissue removed will show pigmentation and proliferation beyond the area in which pigmentation can be detected by the naked eye. If the extirpation is not sufficiently wide, not only has pathologic tissue been left *in situ*, but also more harm than good may have been done by opening channels of metastasis into subepidermal layers or into the lymphatic nodes of adjacent regions."

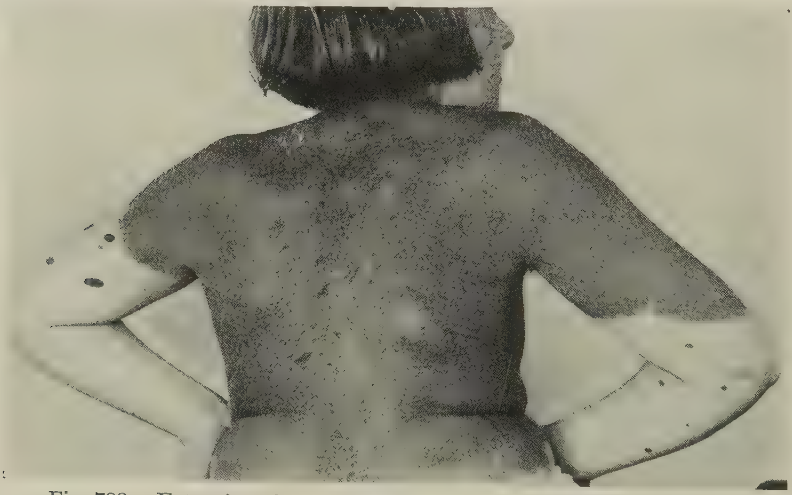

Fig. 788.—Extensive pigmented and hairy mole (bathing-suit type).

Pigmented Macules and Patches (Nevus Spilus).—These nevi are common and may be single or multiple and widely disseminated. They may be apparent at birth or develop at any subsequent time, and once having appeared they persist. Histologically, there are few changes in the skin except for the presence of pigment. Granules of melanin are found in the basal and prickle cells, and occasionally in the connective tissue cells (melanoblasts) of the upper corium.

The danger in the removal of this type of mole is so slight that the end results, from the point of view of scarring and appearance, deserve consideration. Lesions which are not objectionable cosmetically are best left alone. When unsightly, nevus spilus is most satisfactorily treated by electrodesiccation under local anesthesia, which is introduced beyond the lesion. The accurate control of the destruction made possible by the desiccating current is a valuable aid in leaving the slightest amount of scarring compatible with thorough removal. Rightly or wrongly, the treatment accorded moles is largely governed by the depth of their color. It has been my experience to find that when the lesions are light brown in color, the danger of subsequent malignancy is very slight and the desiccation may be performed in a cribriform pattern with successive treatments until the entire lesion has been eradicated. If this is carefully done, fairly large lesions can be removed without scarring. When the patches are darker in color, treatment in successive stages may entail a little additional danger, and the entire lesion therefore should be thoroughly removed at one sitting. The scarring from this treatment is slight, but is more pronounced than that caused by successive treatments as employed for the lighter lesions.

Electrolysis with the negative electrode is preferred by many workers, and not without good reason. It is a simple method, relatively painless and leaves little scarring. The needle should be inserted at the edge of the lesion and pushed beneath it. With the needle in this position, the pigmented patch overlying it is readily destroyed, and removed by a dull curet.

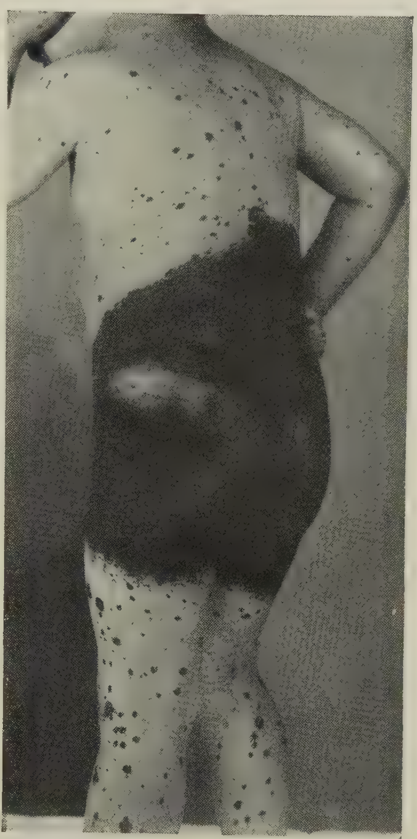

Fig. 789.—Pigmented and hairy mole, bathing-trunk type, with outlying satellites. (Courtesy of Dr. A. Benson Cannon.)

Other forms of therapy are often effectively employed. Small lesions may be eradicated by caustics, such as sodium ethylate and nitric acid. A scab forms which on being separated leaves no appreciable amount of scarring and pigmentation. Carbon dioxide snow is occasionally employed, but inevitably produces scarring.

Soft Moles (Pigmented Moles).—These may be of numberless kinds, varying widely in size, elevation, pigment content, and other factors. The loose term "nevus pigmentosus" is applied to those containing pigment, and other descriptive names are attached to lesions in accordance with their structural components, clinical appearance, or distribution. There is a possibility that all soft moles are potentially malignant, but experience proves that many of them may be eradicated with safety. Indeed, some varieties seem practically innocuous and others gravely dangerous. For therapeutic purposes it is well to differentiate several types.

(*a*) *Fleshy, Pedunculated Soft Moles.*—These are flaccid appendages, usually nonhairy, and sparsely pigmented, occurring upon the back, abdomen, axillae, groins, and face. It is occasionally impossible to tell whether these lesions are soft fibromas or moles, for clinically they may be moles, whereas pathologically they are called fibromas because nevus cells are absent. With such a conception, the pathologist would classify most of our verrucous linear nevi as warts, for nevus cells are infrequently present in these lesions. Attention is called to this fact to avoid criticism for placing these fleshy, pedunculated soft lesions in this category.

These are readily removed without hazard. An easy procedure is to grasp the mole with a pair of forceps, freeze it with ethyl chloride, and clip it from its base with a small pair of scissors. The larger lesions may be removed by a scalpel under local anesthesia.

(*b*) *Small Soft Hairy Moles* (*Nevus Pilosus*).—These nevi are usually about the size of a pea. They are common upon the face and neck, and are treated by the thousands in beauty parlors. The amount of pigment in them varies considerably, being sparse or profuse. The average lesions are light yellow or light brown. The hairs present should be removed by electrolysis, which often suffices to cure small moles. Larger lesions may be transfixed, the needle being attached to the negative pole and inserted diametrically across the entire lesion with a current of 2 to 3 ma. After electrolysis extensive patches are desiccated with the high frequency current under local anesthesia. Following thorough desiccation, the mole is lifted with forceps and the base is cut with a small pair of curved scissors to the level of the skin. This method of removal entails practically no scarring. There is the possible disadvantage of incomplete removal of the nevus, for probably upon microscopical examination some residue may be found in the underlying skin. However, it is a method which is based largely upon cosmetic considerations and entails no prolonged irritation such as results from the caustics that are largely employed for this purpose. In suitable locations preference over this method should be given to surgical excision and closure by horsehair sutures.

In the course of years there is a tendency for these lesions to become slightly darker in color and fibrotic. Unless there are apparent degenerative changes, such as fissuring, crusting or bleeding, or evidences of growth or marked pigment increase, these moles may seemingly be treated without undue hazard. Upon degenerative, growing, or deeply pigmented lesions, wide and thorough surgical excision should be practised. This treatment also applies to infected moles. Infection, which usually results from the patient pulling the hairs from the mole, subsides after a few days under treatment by wet dressings. After the inflammation has abated, excision is indicated.

(*c*) *Black, Bluish-black, or Brownish-black, Flat or Rounded Moles.*—These show varying degrees of elevation, are generally hairless, and have a tendency to form crusts, which drop off from time to time. They are the most dangerous type of nevus from the standpoint of malignancy, and require most radical treatment when there is any evidence of increase in size or deepening of pigment. Vicious developments from this type of mole are possible. If left untreated, these lesions tend outstandingly to degenerative changes followed by the development of melanoma, and even if treated most carefully and thoroughly, this dreadful disease may not be prevented.

Such moles exposed to irritation from friction and maceration demand treatment. Others which are not so subjected are also best treated, but may be kept under observation unless there are changes in them suggesting activity. For the treatment of apparently inactive lesions, wide surgical excision is recommended. When the lesions are growing larger or darker, or are ulcerated or papillomatous, massive doses of radium are advisable prior to this. Surgical removal, however, should not be delayed. Radium can claim cures of numerous melanomas that have not metastasized otherwise than by forming local satellites, although the cells composing them are tolerant to large doses.

Other methods of treatment of pigmented moles are endothermy, refrigeration, or x-ray treatment. While complete removal by the high frequency cutting current skilfully done has an advantage over surgery in that the vessels are sealed by the heat of the current simultaneously with the removal, thus lessening the dangers of metastasis; the practical disadvantage is that the trauma involved in its use is greater than that resulting from the surgical excision and the healing is usually not as undisturbed. Although presumably, if the growth is completely removed, the type of healing which occurs subsequently should be of no importance; it is perhaps a little safer to leave the tissue, after the removal of a growth, in as healthy a state as possible, without the irritation of exudates, sloughs, crusts, or dry scabs. Some cures of melanomas that have not widely metastasized can be accredited to x-ray treatment and carbon dioxide snow, but these two methods are inferior to surgical excision.

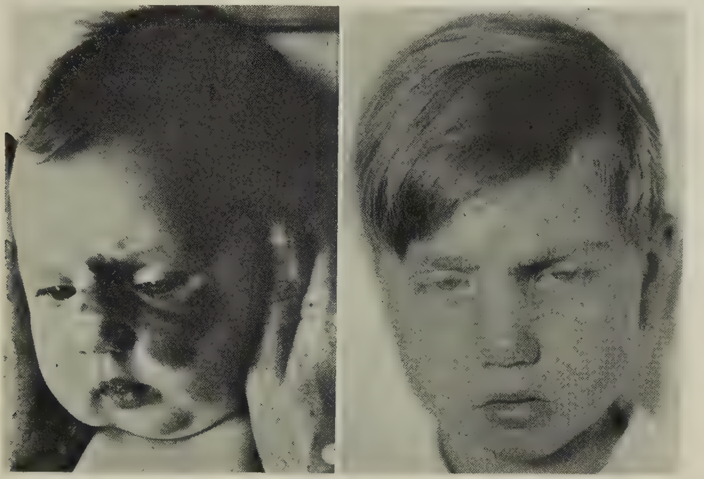

Fig. 790. Fig. 791.

Figs. 790, 791.—Pigmented and hairy mole. Before and after treatment by carbon dioxide snow, with very small doses over a period of years, in which manner minimal scarring resulted.

(*d*) *Brownish, Slightly Elevated, Nummular or Larger Moles.*—These vary greatly in size and appearance, sometimes being as large as the palm of the hand, or even so extensive as to involve the entire body (bathing-suit type). They are usually covered with hairs, and when extensive, the affected skin may resemble that of an elephant or monkey, being brown, thick, wrinkled, and hairy.

As in other types of soft moles, the danger ascribed to them is largely influenced by the depth of their color. Extensive hairy, brownish moles are generally treated as cosmetic conditions. When the lesions are deep in color or have a blackish tint, their potential danger is considered greater, and although the cosmetic results deserve consideration, thorough removal is more important. If left alone, such darkly pigmented moles, in the course of years, are liable to become larger and thicker and occasionally develop crusts and nodular thickenings, melanoma satellites, or metastases. In young individuals these changes are less common, and as such lesions are usually submitted for treatment during childhood, thorough eradication can generally be accomplished before degenerative or hyperplastic changes occur.

When this type of mole is amenable to surgery, wide excision followed by skin grafts is advisable. The hemostasis caused by the high frequency cutting current is specially useful in the treatment of large thick, deeply pigmented, hairy nevi on the cheeks. First, a section is made down to fat about the entire periphery of the mole, approximately $\frac{1}{4}$ inch beyond its margin. Secondly, the edge of the nevus flap is lifted and removed by lateral section in a plane parallel to the skin surface and through the fat underlying the nevus. Preliminary epilation is unnecessary. Even without skin grafts, the cosmetic results are good.

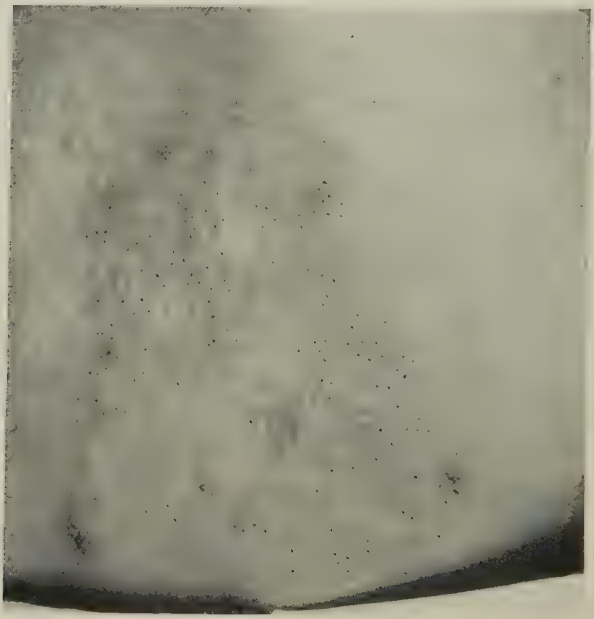

Fig. 792.—Nevus follicularis of the back.

Upon lesions so extensive that these methods are not feasible, coagulation with the high frequency spark by means of a bipolar current, gives complete destruction and affords the best possible result. Radium, carbon dioxide snow, the actual cautery, and other methods have been, and are, used with some success in the treatment of the widespread hairy, pigmented moles, but because of the accuracy of the destruction by surgical diathermy, it is especially suited to this condition. The destruction caused by carbon dioxide snow is incomplete as to depth and occasionally as to the size of the affected area. Radium is entirely unsuitable for the treatment of this type of mole, because it has no selective action upon the stationary and inactive lesions, and for the same reason roentgen therapy is even less desirable. Electrolysis and caustics such as nitric or trichloracetic acids are to be avoided as they cause irritation which may lead to malignant changes.

(*e*) *Lobulated, Fatty Nevi.*—These are frequently of waxy appearance, and contain fat and nevus cells or sebaceous gland tissue. They are usually not hairy. As time progresses they may assume a papillomatous or verrucous tendency, or may decrease in size or elevation. Various types have been given distinctive terms, such as nevus papillomatosus, nevus sebaceus and nevus cerebelliformis. Complete surgical excision is preferable to any other form of treatment. In older persons, where degenerative or hyperplastic changes have become manifest, massive radium treatment is sometimes warranted prior to excision. These lesions should be widely extirpated, as remnants left in the tissues are prone to neoplastic changes.

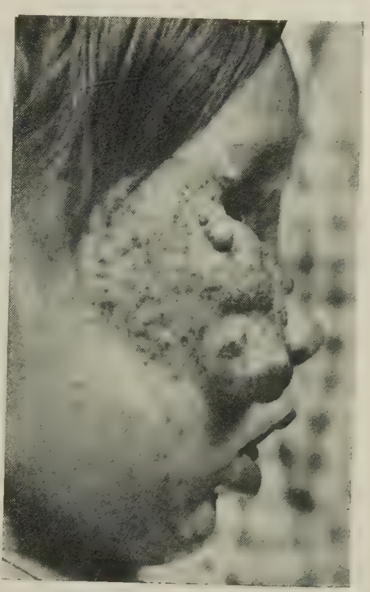

Fig. 793.—Extensive nevus of mixed type containing large amounts of pigment, nerve fibers and ganglion cells, in a child.

Hard and Verrucous Nevi.—This group is of epithelial origin. The lesions vary greatly in size, distribution, appearance, and pigment content, and, with a few exceptions, are hairless. Many are known as *linear nevi*, being arranged in continuous or broken-up streaks, bands, or patches with seemingly segmental distribution. Upon the extremities their course is longitudinal and upon the trunk it is transverse or curved as if

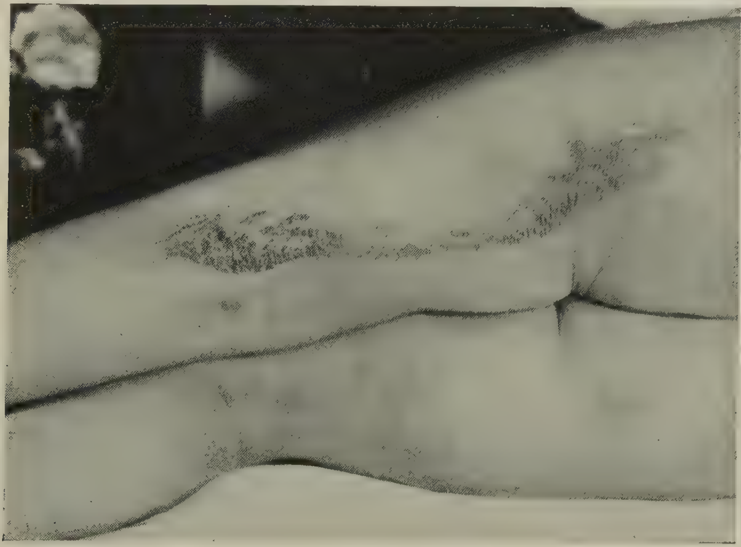

Fig. 794.—Nevus linearis.

along the distribution of the intercostal nerves. Extensive cases occur in which practically the entire body is involved more or less symmetrically

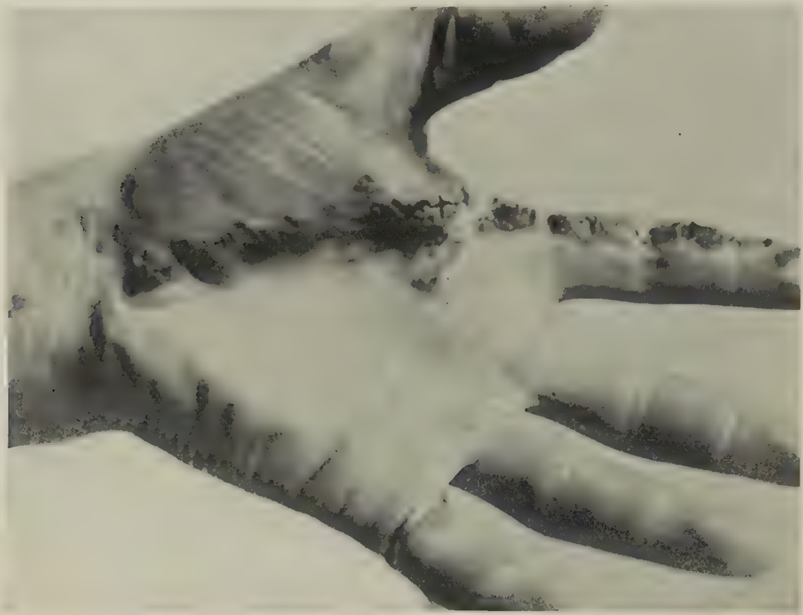

Fig. 795.—Ichthyosis hystrix. (Courtesy of Dr. Edward A. Oliver.)

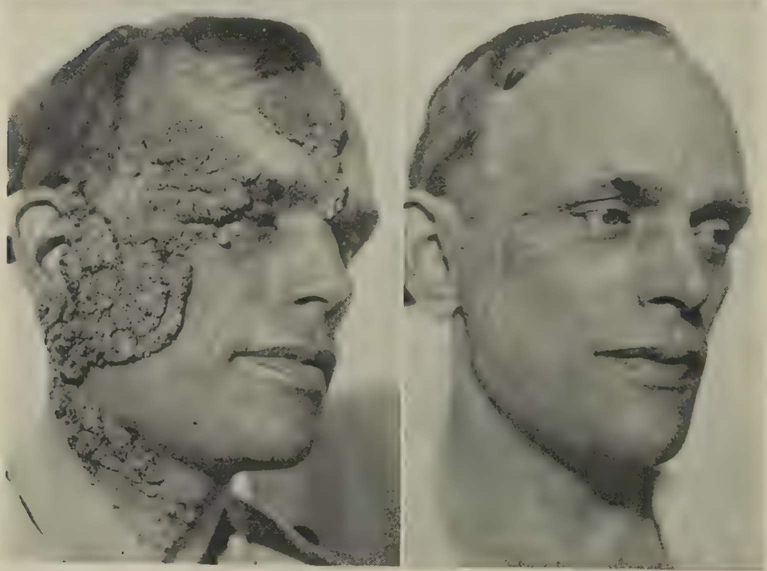

Fig. 796. Fig. 797.

Figs. 796, 797.—Verrucous nevus treated by electrocoagulation. (Courtesy of Dr. Joseph V. Klauder.)

(systematized nevi). The individual lesions are papular, and flesh, pinkish, violaceous or brownish color, and occasionally of warty or drab appearance. More rarely, acneiform lesions or large horny excrescences are observed.

These nevi have an extensive nomenclature suggested by their individual variations: Nevus verrucosus, nevus unius lateris, nevus follicularis keratosus, nevus acneiformis unilateralis, and ichthyosis hystrix. Isolated single small lesions are sometimes called *congenital warts*. In some cases, often familial, these lesions are widely disseminated over the trunk (nevoid keratoses) and simulate multiple seborrheic keratoses, except that there is no seborrhea.

Nevus cells, such as found in moles, are rarely present. The principal changes in the corium are a moderate perivascular infiltration and the presence of occasional plasma cells or melanoblasts. The changes in the epidermis are hyperplastic and affect chiefly the corneous layer, follicles, glandular or periglandular structures. Groups and strands of cuboidal cells from the epidermis or glands often extend downward into the corium.

Each lesion presents an individual therapeutic problem, according to the apprehension caused by its clinical picture, the importance of scarring, the age of the patient, and the amount of pigment and hair present. The prime consideration in each case is the therapeutic procedure which will give thorough removal with the least amount of scarring. Upon the smaller growths this is a relatively simple matter, but the larger lesions present a more difficult problem, in which resourcefulness frequently gives well-deserved rewards.

In general, these nevi are best treated by electrodesiccation under novocaine. Excellent cosmetic results, as well as thorough removal, are rapidly attained by this technic. Excision by the scalpel or cautery is also a suitable procedure in many instances. Curettage followed by caustics, and refrigeration are less commendable methods. Occasional benefit has been derived from irradiation with both x-rays and radium, but these results are offset by an equal number of cases showing all degrees of chronic radiodermatitis from the excessive use of these agents. The selective action of irradiation upon verrucous nevi is so slight that it is rarely useful, and radiotherapy can nearly always be supplanted by some other method which produces less scarring.

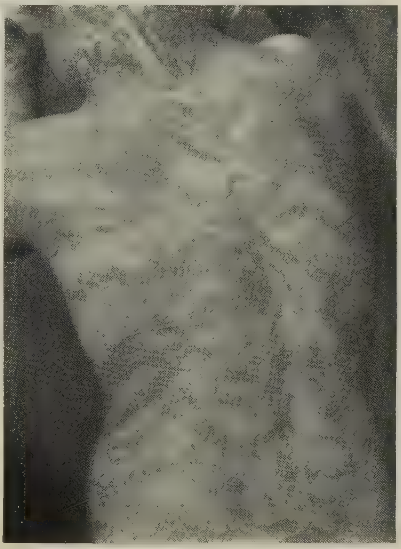

Fig. 798.—Systematized verrucous nevus (ichthyosis hystrix). (Courtesy of Drs. J. B. and Bedford Shelmire.)

Dermatosis Papulosa Nigra.—This disorder occurs almost exclusively in negroes, among whom it is fairly common, and was first identified by Castellani in Central America. It usually begins in childhood, showing first as minute round skin-colored or hyperpigmented papules that develop singly or in sparse numbers on the malar regions or on the cheeks below the eyes. The lesions increase in number and in size so that in the course of years the average case presents from thirty to fifty lesions. These closely simulate verrucae planae both in size and shape. They do not itch or produce other subjective symptoms. There is no scaling, crusting or ulceration, and the lesions never seem to disappear spontaneously. Microscopically, the chief alterations are in the epidermis, being characterized by an irregular acanthosis and a deposit of uncommonly large amounts of pigment throughout the rete and particularly in the basal layer. Michaels and Seale consider the disorder a form of verrucous nevus. Treatment is by electrolysis.

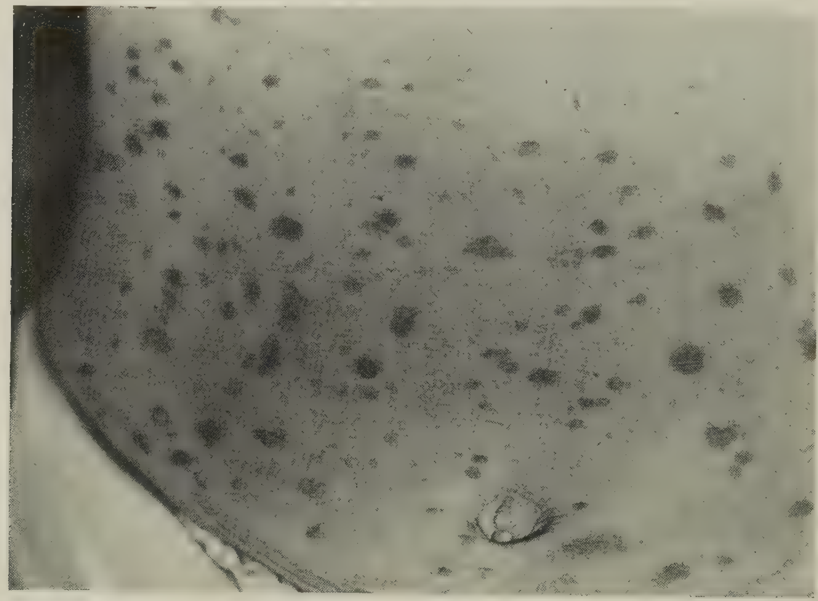

Fig. 799.—Nevoid keratoses on the abdomen. This patient and her sister, both in the early thirties, had similar lesions scattered profusely over their bodies, and neither had any evidence of seborrhea.

ADENOMA SEBACEUM

Synonym.—Nevus sebaceus.

This is a rare affection of congenital origin which may not appear until adolescence. It is characterized by pinhead-sized yellowish or reddish, translucent, waxy papules, situated on the flush areas of the face and often associated with capillary telangiectasia and other congenital anomalies, and mental deficiency. However, the intellectual development of many persons affected by adenoma sebaceum is normal. The lesions are usually discrete but may coalesce. They are located principally over the cheeks, nose, and forehead, particularly on the sides of the nose, but may occur rarely on other parts of the body. The arrangement is bilateral and symmetrical. The lesions persist indefinitely and their number may be augmented by new ones.

Two types of adenoma sebaceum are recognized—the Balzer type and the Pringle type. In the former the sebaceous glands are predominantly involved, whereas in the latter the blood vessels are especially affected. McCafferty and Lopez have studied these types histologically and state that the Balzer type shows chiefly a hyperplasia of the sebaceous glands, while the Pringle type shows a simple hypertrophy of the sebaceous gland lobules and a dilatation of the blood vessels.

Actual destruction of the lesions is the most efficient method of therapy. This is best accomplished by electrodesiccation or a fine pointed cautery, and if it is carefully done the scarring will be imperceptible.[1] Usually no anesthetic is necessary, although occasionally in lesions located on the eyelids novocaine is required. Electrolysis may be employed successfully, but is a very tedious procedure. Some improvement is also manifested after blistering exposures of air- or water-cooled ultraviolet light. Radium and roentgen therapy have proved of no value in my hands in the treatment of this disease.

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[1] Case demonstrated at a Meeting of the Section of Dermatology and Syphilis at the New York Academy of Medicine and reported in Arch. Dermat. and Syph., 13: 590, April, 1926.

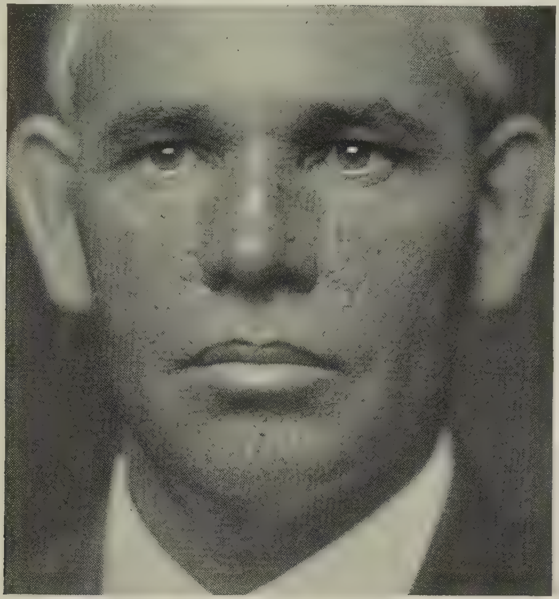

Fig. 800.—Adenoma sebaceum. Five cases in same family. (Courtesy of Drs. J. B. and Bedford Shelmire.)

EPIDERMOLYSIS BULLOSA

Synonyms.—Epidermolysis bullosa hereditaria, congenital traumatic pemphigus, acantholysis bullosa.

This is a rare disease of the skin, which is generally noticed at birth or soon after, and is characterized by the development of vesicles, bullae, and epidermal cysts. Apparently the condition has a familial tendency, explained by hereditary deficiencies in the skin which result in increased vulnerability. The lesions develop chiefly upon the extensor surfaces of the joints and other areas exposed to trauma, but may be encountered on the buccal mucosa.[1] A favorite site for the cysts is on the rim of the ears.

The lesions develop after mild irritation or trauma and in the course of time rupture and heal, leaving pigmentation. In cases of long duration the repeated outbreaks may produce scarring and atrophy, and in some instances the trophic changes involve the deeper structures and lead to claw-like hands and other contractures. Whereas most of the cases of epidermolysis bullosa begin during infancy, the disease has been known to manifest itself first during adult life. Such cases are called the acquired type of the disease.[2]

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[1] Tobias, N.: Lesions of the Mucous Membranes in Epidermolysis Bullosa, Arch. Dermat. and Syph., 18: 224–230, Aug., 1928.

[2] Wise, F., and Lautman, M. F.: Epidermolysis Bullosa Beginning in Adult Life: The Acquired Form of the Disease, J. Cutan. Dis., 23: 441–460, June, 1915.

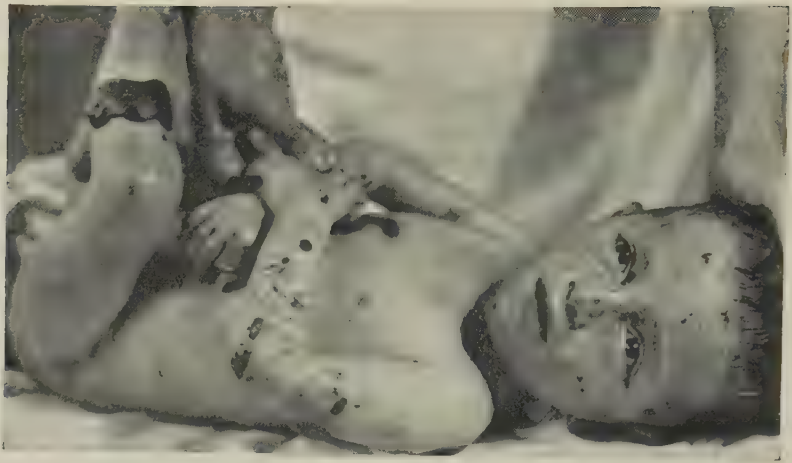

Fig. 801.—Epidermolysis bullosa hereditaria. (Courtesy of Babies' Hospital.)

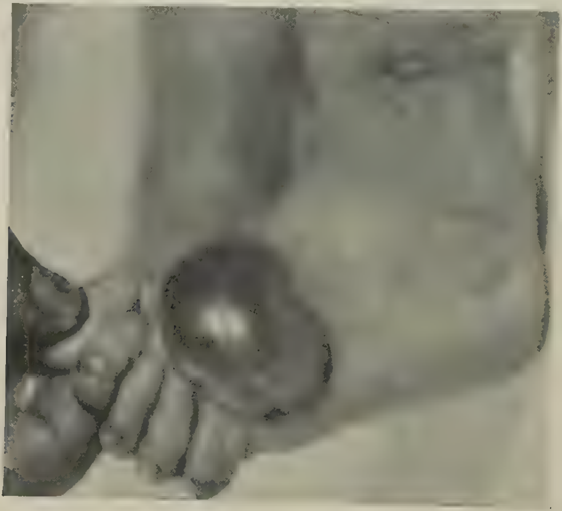

Fig. 802.—Epidermolysis bullosa hereditaria. (Courtesy of Babies' Hospital.)

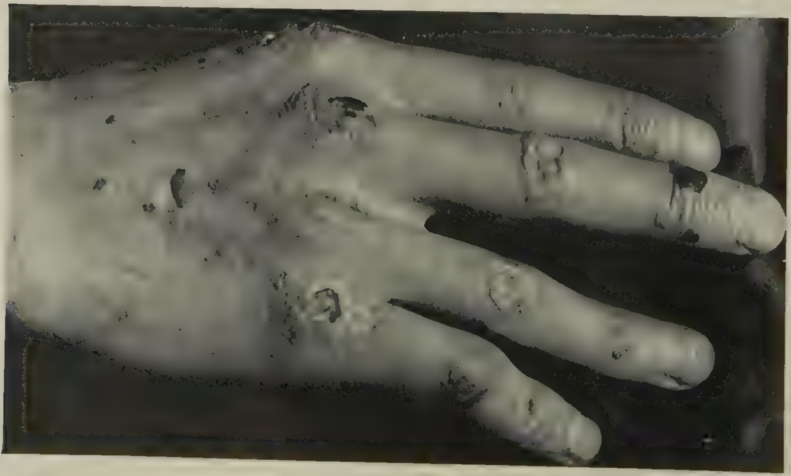

Fig. 803.—Epidermolysis bullosa acquisita. (Courtesy of Dr. Benjamin F. Ochs.)

Treatment.—The only means of alleviation is protection from trauma and secondary infection, for no form of treatment is successful. When the child is the product of a consanguineous marriage, blood transfusion from a person outside the family may be tried.

ICHTHYOSIS

Synonyms.—Fish-skin disease, ichthyosis simplex, ichthyosis vera, xerodermia, sauriasis, ichthyosis congenita, keratoma malignum congenitale, harlequin fetus, ichthyosis foetalis gravior, hyperkeratosis universalis congenita.

Ichthyosis is a congenital abnormality of cornification, associated with dryness, scaliness, and warty growths. Under this category are grouped a number of conditions, to which an extensive nomenclature is applied.[1] The common variety known as ichthyosis simplex, and in mild forms, as xeroderma, usually begins during the second year of life and is characterized by the presence of dirty gray, dry, rough or slightly scaly skin,

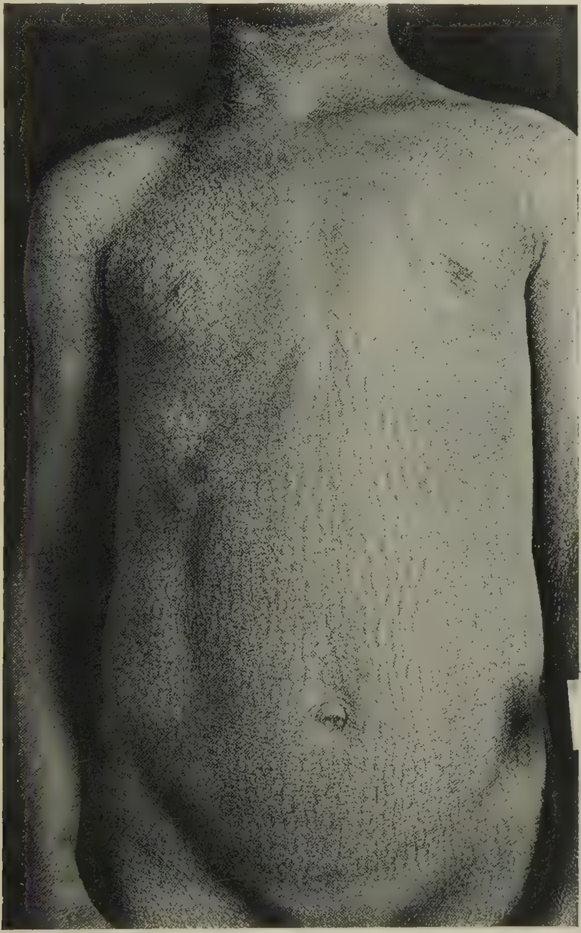

Fig. 804.—Ichthyosis. Note scaling, crinkling, and quadrilation. (Stelwagon.)

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[1] Mumford, P. B.: Xeroderma and Abnormalities of Skin Texture, Arch. Dermat. and Syph., 16: 317–321, Sept., 1927.

frequently broken up by fine fissures and giving more or less the appearance of reticulation. The secretions of the sebaceous glands and occasionally of the coil glands are deficient. The advanced cases are accompanied by more intense thickening, scaling, and loss of elasticity. The harlequin fetus is probably a severe form of the disease affecting the skin *in utero* and causing thick horny, armor-like plates that cover the entire surface and lead to a stillbirth or early death. The term "ichthyosis hystrix" is applied to localized expressions in the form of congenital warts and verrucous nevi which appear on the trunk and extremities. The lesions may involve extensive areas, usually symmetrical, and are arranged in regular arborizations and complex patterns; or they may be unique circumscribed excrescences resembling warts or horns.

The severity of ichthyosis fluctuates with the seasons, being worse in winter and better in summer. The mucous membranes are never involved, but the disease may affect the nails and the hair. The skin is sensitive to external irritation and prone to be affected by eczema and fissures. There is an hereditary tendency, which is probably a result of the persistence of the epitrichium.[1]

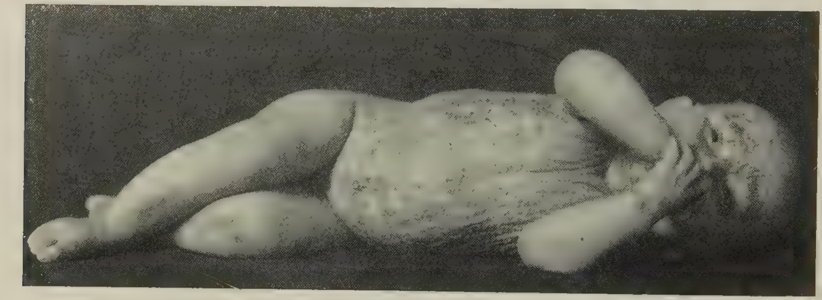

Fig. 805.—Ichthyosis.

Treatment.—x-Rays and ultraviolet light have no lasting effect upon ichthyosis. Temporary improvement frequently results from fractional roentgen therapy, which is especially suitable where the condition has become eczematized. Generalized air-cooled ultraviolet therapy was persistently used by the author in one case, and it seemed to do some good. Hot alkaline baths containing borax or sodium bicarbonate, or baths containing starch or bran soften the skin and diminish the scaling. Inunctions with cocoa butter and other bland oils, to which 2 to 5 per cent salicylic acid may be added, are beneficial. Numerous other applications are occasionally of value. The clothing should be warm and of a fine texture to avoid irritation. The lesions of ichthyosis hystrix may be removed by surgical diathermy.

Thyroid extract, pilocarpine, or iodine is given internally. Of these remedies thyroid extract is the most important. It must be continued for long periods and given in fairly large doses to cause improvement, for the disease tends to relapse when this treatment is discontinued.

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[1] Bowen, J. T.: The Epitrichial Layer of the Epidermis and Its Relationship to Ichthyosis Congenita, Jour. Cutan. and Genito-urinary Diseases, 13: 485–491, Dec., 1895. Frick, W.: Three Cases of Ichthyosis in One Family, J. Cutan. Dis., 15: 19–20, Jan., 1897.

KERATOSIS PILARIS

Synonyms.—Lichen pilaris, pityriasis pilaris, ichthyosis follicularis, follicular xeroderma, ichthyosis cornea, keratosis follicularis, ulerythema ophryogenes.

Keratosis pilaris is a follicular affection in which horny accretions of about pinhead size give the skin a stippled appearance resembling goose flesh. It is most pronounced during the winter months in those with dry skin and may occur at any age, although it is most common during adolescence. Keratosis pilaris has a predilection for the extensor surfaces of the arms and thighs. In the severer cases the lesions are generalized.

The individual lesions are pinpoint to pinhead sized, follicular, acuminate papules. These may or may not be erythematous; more often they appear grayish because of the superimposed keratotic cone. The latter is composed of epithelial cells and inspissated sebum collected about a hair shaft, which at times is found coiled and wrapped up in them. Sometimes these corneous plugs are the most prominent feature of the eruption, whereas at other times they are present in only small numbers and most of the lesions are punctate erythematous papules. Forcible removal of one of the plugs leaves a minute cup-shaped depression at the apex of the papule, which is soon filled by new keratotic material. The lesions tend to be arranged in poorly defined groups, dotting the otherwise normal skin in a fairly regular pattern. They are prone, however, to appear in xerodermatous subjects. Due to the coiled hair embedded in many of the papules, which acts as a foreign body irritant, secondary infection by the staphylococcus is common, with the production of multiple small white-capped pustules. The exact etiology of the condition is disputed although it seems to be of congenital origin, and is possibly a follicular form of ichthyosis.

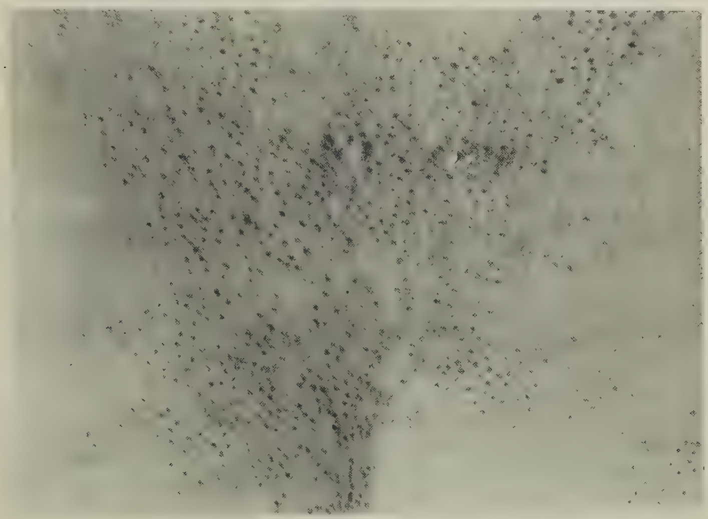

Fig. 803.—Keratosis pilaris. Close-up view.

Under the title **"ulerythema ophryogenes"** a similar disorder occurs in the eyebrows, from which it may spread to the neighboring skin and even involve the scalp. The affection is characterized by a persistent erythema, and small horny, follicular papules, which upon involution leave depressed scars and atrophy, with resulting alopecia. In some respects this disorder also simulates lupus erythematosus, from which it is, however, a distinct entity.

Lichen spinulosus is an allied disorder, which is described separately on page 980.

Treatment.—The treatment is similar to that for ichthyosis. Mild keratolytics, such as resorcin or salicylic acid, 2 to 5 per cent, in diachylon ointment and softening lotions for use after bathing, are usually sufficient.

Fractional roentgen-ray treatment results in temporary but rather prolonged involution of the lesions. Three or four exposures of $\frac{1}{4}$ E. D., unfiltered, cause the condition to disappear, although occasional recurrences after a year or two are not uncommon. The best results are derived from combining roentgen therapy with the use of weak salicylic acid ointment.

KERATODERMIA PALMARIS ET PLANTARIS

Synonyms.—Hyperkeratosis congenitalis palmaris et plantaris, ichthyosis congenitalis palmaris et plantaris, keratoma palmare et plantare hereditarium, tylosis palmare et plantare.

This condition is characterized by a marked congenital thickening of the epidermal horny layer of the palms and soles, usually symmetrical and affecting all parts to an equal degree. At times the thickening extends to the lateral or dorsal surfaces, especially over the knuckles. When the keratodermia is on the sole, the instep is generally not affected. The epidermis becomes thick, yellowish, and horny, and the surface is smooth, pitted or verrucous. Keratosis punctata is a variety in which the hyperkeratosis is localized to multiple points. These are small flat, pinhead-sized, yellowish-gray, horny projections that leave pits when they are forcibly removed. In the ordinary variety the uniform thickening forms a rigid plate, which ends

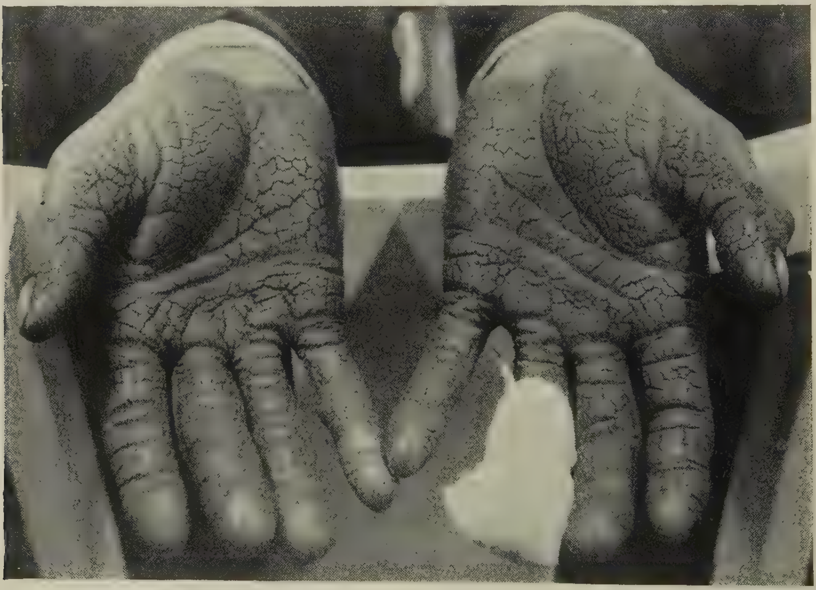

Fig. 807.—Keratodermia palmaris. Seven members of family show same condition—father, grandfather, great grandfather, three brothers, and one sister. Soles similarly affected. (Courtesy of Dr. Samuel T. Millard.)

with characteristic abruptness at the periphery of the palm, usually without any contiguous inflammatory margin. In the acquired cases such a zone is as a rule present, appearing as an erythematous band at the edge of the horny plate; and there is frequently hyperidrosis, which causes a sodden appearance. Occasionally there are associated changes in the nails, which become thickened, opaque, and malformed.

Temporary benefit sometimes has been achieved by roentgen therapy. The dosage should always be kept below an erythema. There is little preference between filtered and unfiltered technic; with either method the dosage should always be fractional.

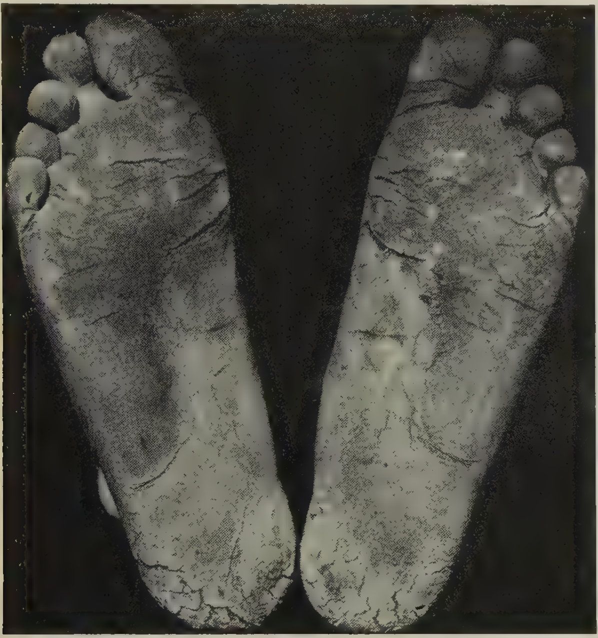

Fig. 808.—Keratodermia plantaris. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

Local medicinal agents are rarely of value. Salicylic acid, resorcin, and chrysarobin in ointments or lotions are the most effective drugs. In one case treated by the author, the thickened skin was removed by successive treatments of electrodesiccation during the course of three weeks, and the new skin which grew was pliable and soft.

POROKERATOSIS (Mibelli)

Synonyms.—Keratodermia excentrica, hyperkeratosis excentrica, hyperkeratosis figurata centrifuga atrophica.

This is a rare condition of hereditary origin due to a chronic inflammation of the sweat ducts, which leads to the formation of slightly atrophic patches surrounded by an elevated, warty border. The early lesion is a small horny excrescence which spreads to form a ring. By peripheral extension and central involution there is formed a rounded, lobulated or festooned patch. Usually the enclosed skin is dry, hairless, and in other ways slightly atrophic, and it may rarely be slightly erythematous. The surrounding corneous ridge is a

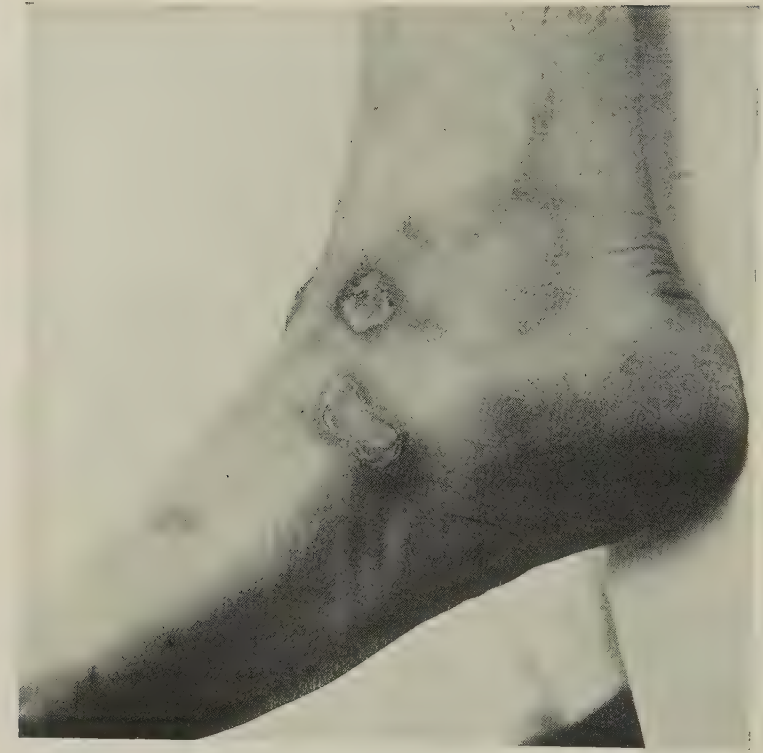

Fig. 809.—Porokeratosis, showing circinate spots with raised ridges and atrophic centers. (Courtesy of Dr. Carroll S. Wright.)

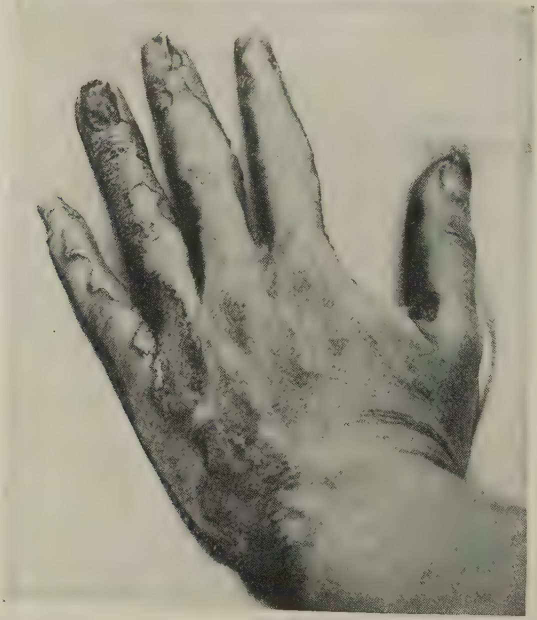

Fig. 810.—Porokeratosis, showing involvement of nails. (Courtesy of Dr. H. W. Barber, London, England.)

characteristic feature, being most pronounced when located on areas subject to friction and pressure, such as the dorsa of the feet and hands. The ridge is brownish and, according to MacLeod, is triangular in transverse section. Sites of predilection are the surfaces of the hands and fingers, the feet, and ankles. The disease also occurs on the face, scalp, and other areas, including the buccal mucosa, where the ridge becomes macerated by moisture and appears as a milky-white raised cord. The onset of the disease is early in life and it persists indefinitely, with a tendency to irregular progress. The etiology is not entirely clear, but the disease has a familial tendency and it is presumed that heredity plays a causative rôle. Possibly it is a peculiar variety of verrucous nevus. Histologically, the principal changes are in the epidermis, where there are a marked hyperkeratosis and parakeratosis, particularly pronounced about the openings of the sweat ducts. Changes in the corium consist of mild, simple inflammatory infiltration, and atrophy, especially of the glands. Treatment is by excision or electrocoagulation.

CONGENITAL ECTODERMAL DEFECT

There are numerous anomalies of the epidermis and appendages due to faulty evolution of the epiblastic layer of the blastoderm. The term "ectodermal defect" has been limited to those conditions arising from incomplete development of the epidermis or its appendages, or its absence in circumscribed areas, thus excluding the keratodermias and the nevi. Congenital atrichosis with or without deformities of the nails and teeth is common, and is accompanied at times by nevi and other congenital anomalies. Congenital absence or malformation of the nails and teeth is also of frequent occurrence, and in circumscribed areas it is not out of the ordinary to find that the sebaceous and sweat glands are absent or impaired. In restricted areas there may be a complete absence of the epidermis and appendages at birth. It is more rare to encounter cases of extensive deformation or complete absence of all, or nearly all, of the cutaneous structures originating from the epiderm, to which group the term "congenital ectodermal defect" is given. Guilford, an American dentist, was the first to report a case of this kind. The appearance of these patients is typical and conspicuous, as they have a facies that is suggestive of congenital syphilis. The skin is hairless, dry, white, smooth, and glossy. The teeth are entirely absent or there may be a few present, but the development is always defective. There are dystrophic disturbances in the nails. The scalp hair is sparse and of a fine soft texture. The cheek bones are high and wide, whereas the lower half of the face is narrow. The supraorbital ridges are prominent; the nasal bridge is depressed, forming a "saddleback nose." The tip of the nose is small and upturned, while the nostrils are large and conspicuous. The eyebrows are scanty, none being present on the outer two thirds. The eyes slant upward, producing a Mongolian facies. At the buccal commissures radiating furrows, "pseudo-rhagades," are present, and on the cheeks there are telangiectases and small papules simulating milium and adenoma sebaceum. The lips are thickened, the upper one being particularly protrusive.

The patient studied by Dr. MacKee and myself never sweat. He was uncomfortable during hot weather due to elevation of body temperature and was unable to play baseball and running games with other boys of his age, because of great fatigue induced by such exertions. These symptoms resemble those in other cases reported in the literature, and not uncommonly the subjects find it necessary during the summer to have pails of water thrown over them if they are to keep comfortable.

The affection is familial, generally affecting males, and seems to be due to an injury during the third month of uterine life. Some of these patients are mentally deficient, but the majority of them have normal mentality because the anlage of the nervous system is distinct from the cutaneous ectoderm long before the injury occurs. MacKay and Davidson report 4 cases occurring respectively in a woman, aged thirty-four years, and her two sons and one daughter, aged six, eleven, and thirteen years.

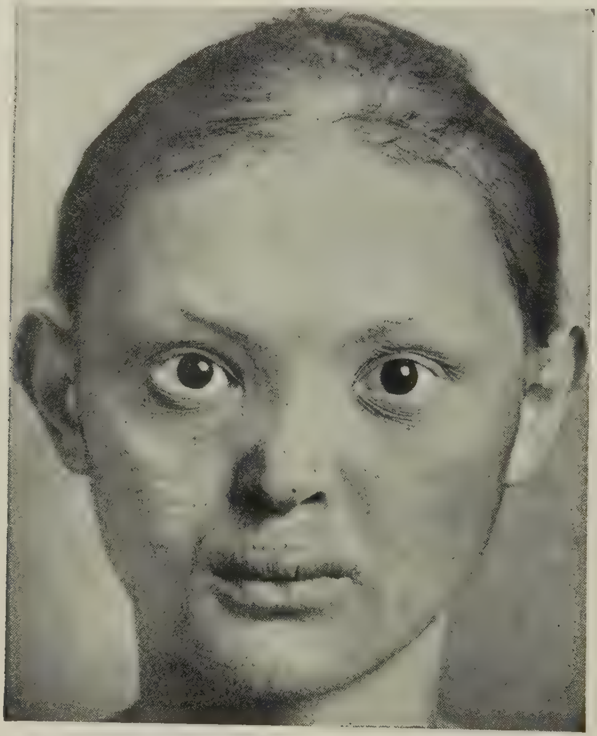

Fig. 811.—Congenital ectodermal defect. (Courtesy of Dr. George M. MacKee.)

Innumerable other congenital anomalies of the skin have been recorded, including congenital elephantiasis, hyperplasticity, and regional hypoplasia.

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CHAPTER XXIX

BENIGN NEOPLASMS OF THE SKIN

EPIDERMIS

MANY of these neoplasms have been proved infectious although the specific virus has not been isolated. Those known as the benign infectious epitheliomas, comprise verruca vulgaris, verruca plana, verruca plantaris, molluscum contagiosum, and condylomata acuminata.

VERRUCAE (WARTS)

Common warts may be separated into four varieties: (1) Verruca vulgaris, the familiar raised warts so frequently encountered on the hands; (2) verruca plana seu juvenilis, the flat or plane warts that occur on the hands and face, mostly in childhood; (3) verruca plantaris, the papillomatous horny and cornlike excrescences that develop on the soles and rarely on the palms, at sites of pressure; (4) verruca acuminata, the pointed condylomata or filiform, macerated or horny lesions which occur in moist folds about the genitals or anus. Some individuals and families seem predisposed to the development of warts of all kinds, at all ages, and in others they are unknown.

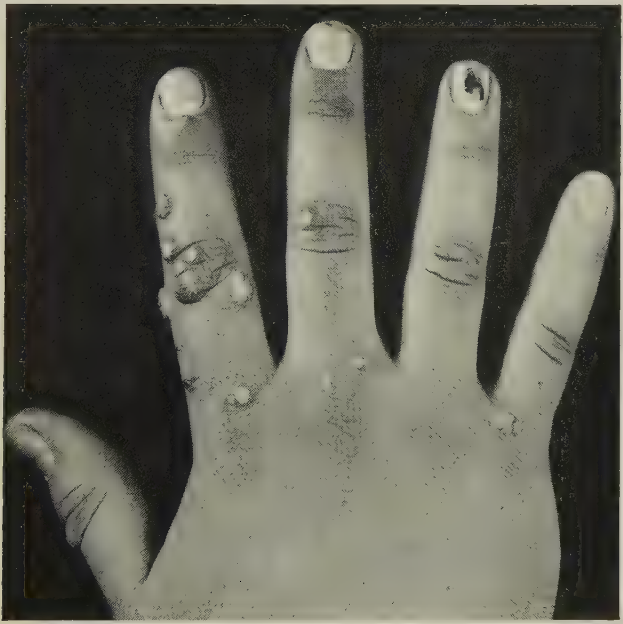

Fig. 812.—Verruca vulgaris, common distribution.

Verruca vulgaris occurs chiefly in children about the ages of twelve to fifteen years, on the dorsa of the hands and on the fingers. At these ages warts reach their most profuse growth, being usually multiple and numerous, sometimes a hundred or more. In adults they rarely are so numerous, two or three lesions being a common number. Warts may occur any place on the skin, and even on the lips, in the nostrils or auditory meatus, on the edges of the eyelids, or on the tongue. Generally they are spread to the tongue by the habit of biting the finger-nails, about and under which they frequently grow. On the surfaces of the eyelids, on the scalp in association with seborrhea, and occasionally about the mouth and chin a special variety, called verruca filiformis, is encountered, in which the lesions are single, soft, thin, threadlike projections. The scalp is also a common site of involvement for the ordinary variety of warts, and in this place the affection is difficult to eradicate because, in spite of thorough destruction of the warts, new ones develop on other portions. In the beginning common warts are pinhead-sized, smooth, shiny, translucent, usually discrete hyperkeratoses. They gradually grow in the course of several weeks or months to pea-sized, rough, papillary, dirty brown, gray, or black lesions. Rarely they develop to the size of a walnut. The larger lesions, particularly those about the nails, are apt to become fissured, slightly infected, malodorous, and tender. In some instances a single wart—mother wart—appears and grows slowly for a long time and then suddenly many new warts start developing.

Verruca plana seu juvenilis is a pinhead-sized or slightly larger, smooth, slightly raised, flat lesion. These warts are generally multiple and numerous, being grouped on the face, neck, dorsa of the hands, wrists, and knees. The forehead, cheeks and nose, and particularly about the mouth and the backs of the hands are the favorite locations. In these areas they are often excoriated or conglomerate, making the differential diagnosis from verrucous nevi, lichen planus, eczema, and molluscum contagiosum a matter of some difficulty. They tend to spread within scratch marks and thus form linear, slightly raised, papular lesions. Their color is usually that of normal skin, or light brown. Although children are the favorite subjects, these warts occur also in adults. I have gained the impression that their growth is favored by exposure to sunlight.

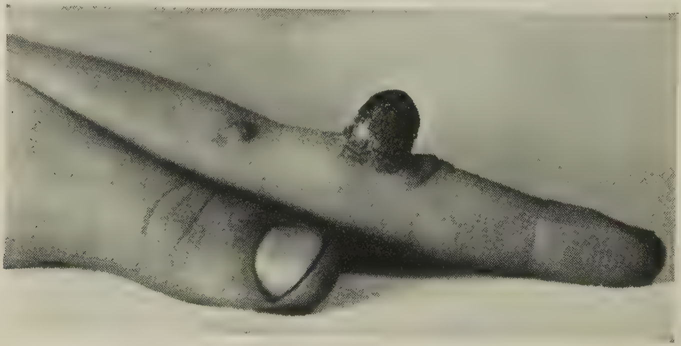

Fig. 813.—Verruca vulgaris.

Verruca plantaris is also encountered most often in young persons, but mostly between the ages of twelve and thirty-five years. These warts generally form at points of pressure on the ball of the foot, but may be scattered over the sole irrespective of pressure. Frequently they are bilateral and roughly symmetrical, although as a rule there are more lesions on one foot than on the other. Sometimes they are grouped, or several contiguous warts fuse so that they appear as one until the keratotic surface is shaved off and the multiple cores are revealed. These cores are soft and pulpy, and are surrounded by a firm horny ring; they occur in no other form of wart, but resemble somewhat the cores in corns. Plantar warts may be confused with callosity, but are more painful and have the soft central core not present in the latter. Often plantar warts and callosities are observed on the same foot.

Verruca acuminata is a small pointed projection, which may multiply and form a large vegetating bunch. These lesions occur in men in the coronal sulcus, on the prepuce, on the frenum, or about the anus; in women on the mucous surfaces of the vulva, on the perineum, or about the anus. Rarely they are found in the axillae, umbilicus, or interdigits. Although usually few in number, cauliflower-like masses, the size of an orange, may develop, and due to an accumulation of purulent material in the clefts between the filaments, may be malodorous. Their color is generally gray, pale yellow, or pinkish. Sometimes they develop rapidly and luxuriantly during pregnancy and in negroes, particularly in those who have a profuse discharge.

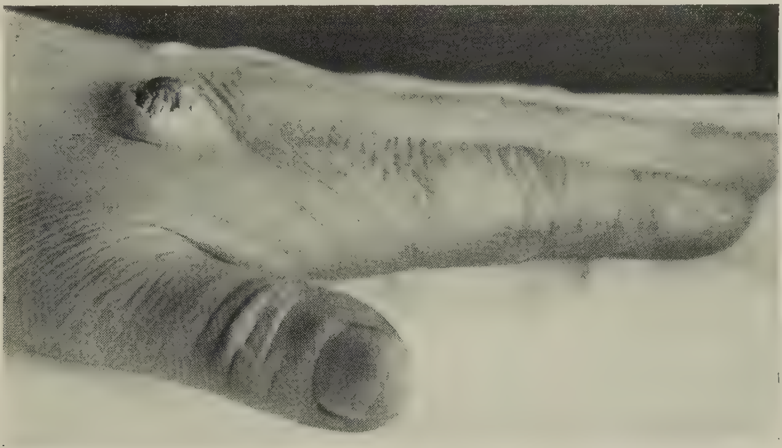

Fig. 814.—Verruca vulgaris, resembling early lesion of squamous-cell epithelioma.

In adults the clinical differentiation of warts from cancer is always important and occasionally difficult. Warts are usually accompanied by other warts and, if so, these assist in the diagnosis. In a single wart the absence of the underlying solid infiltration characteristic of carcinoma helps in the clinical identification. The lack of this distinguishing feature is especially applicable to warty circumscribed lesions on the fingers and dorsa of the hands, which are common locations for each disease. Warts, however, generally occur earlier in life than cancer. On the tongue and lips single warty lesions in adults should arouse suspicion of carcinoma. In these sites the infiltration may not be perceptible clinically, and reliance may have to be placed upon the histology for the diagnosis. To a lesser extent this statement applies to warty lesions on the glans penis, in the coronal sulcus or on the foreskin. Warts upon the fingers may be confused with tuberculosis verrucosa cutis, but in the latter disease the lesions are as a rule larger than common warts, are generally single, occur more in adult males, are more likely to be erythematous and usually are surrounded by an inflammatory zone. Compressed masses of acuminate warts may resemble condylomata lata, but only upon superficial examination.

Although the exact micro-organism which causes warts has not been identified, it has been shown that it is a filtrable virus and the lesions are infectious, auto-inoculable, and transferable from one individual to another experimentally by inoculation. Frequently they appear along scratch marks, at the site of an abrasion, or on contiguous surfaces. The etiologic agent may be slightly different for the several varieties, but in all probability the differences are not great.

Treatment.—Some warts respond to simple treatment, or even disappear spontaneously and rather suddenly, and others are stubbornly recurrent. All cases, however, are cured by persistent therapy.

Certain *internal remedies* are popular but of doubtful value. The more important of these are protiodide of mercury pills, $\frac{1}{6}$ to $\frac{1}{4}$ grain t. i. d.; magnesium sulphate, 10 to 30 grains t. i. d.; thyroid extract or injections of bismuth, sulpharsphenamine, sodium cacodylate, or wart autolysate.

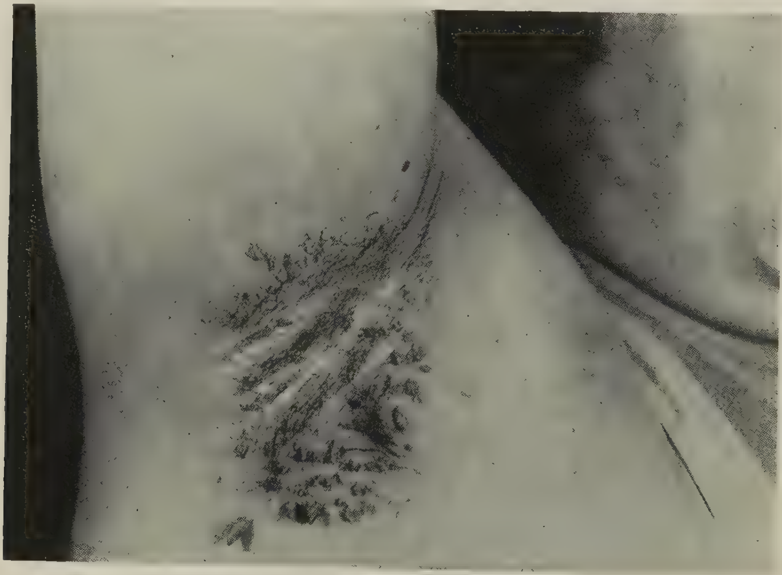

Fig. 815.—Filiform warts of the right axilla.

Among the countless *local methods* of treating warts may be mentioned curettage, excision, fulguration, electrolysis, refrigeration, and the use of the galvanocautery and various escharotics (chromic, nitric, trichloracetic, salicylic, or carbolic acid, tincture of iodine, liquor arsenicalis, or nitrate of silver). These methods are older and simpler than those which are to be described, and possess disadvantages as they are apt to be followed by recurrences, scarring, pain, bleeding, and infection. When skilfully applied in selected cases they may be suitable. Curettage after preliminary anesthesia by ethyl chloride spray is best adapted to small filiform or flat warts. It is usually advisable to follow the removal by painting with a caustic such as trichloracetic acid or phenol to stop the bleeding and prevent recurrences. On children the treatment is generally performed with difficulty, and there is a likelihood of scarring. Excision always leaves a scar, which may be sensitive on pressure. It is often followed by recurrences. The method is applicable mainly to warts in which cancerous changes are suspected, and in which total removal and microscopical examination are desirable. Fulguration, electrolysis, and the galvanocautery are painful methods that leave scars in which keloids frequently form. Refrigeration is also painful. The amount of destruction and scarring from it is more or less a matter of chance and personal experience. All these procedures result in scabs, which invite infection, but those most objectionable from this viewpoint are the medicinal caustics, which produce considerable inflammatory reaction with serous exudation and crusting.

In the following pages preference is given to methods of treatment which cure without scarring, bleeding, pain, or the risk of pyogenic infection. Whereas the treatment of most warts is largely cosmetic, some warts have tendencies to cancerous changes, which necessitate specially suitable and thorough therapy. The choice of the method will also be influenced by the location of the warts, their size and number, the presence of secondary infection or hyperemia, and tenderness due to pressure, the age and sex of the patient, and the history of previous treatment.

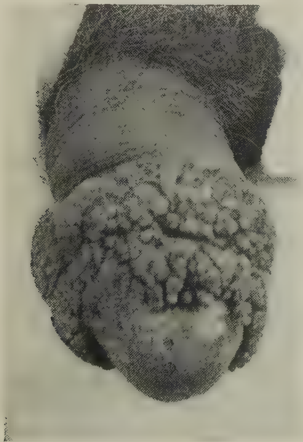

Fig. 816.—Verruca acuminata (venereal warts). (Courtesy of Dr. Mihran B. Parounagian.)

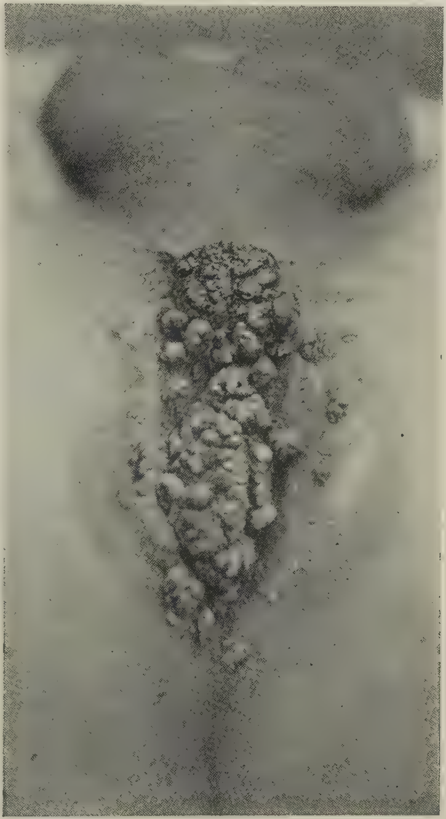

Fig. 817.—Verruca acuminata, perianal. (Courtesy of Dr. A. Benson Cannon.)

Verucca Vulgaris.—1. *Radium.*—Unfiltered radium in doses of from 100 to 300 millicurie minutes is the best form of treatment for most lesions less than 1 cm. in diameter. This method is specially convenient for the treatment of children, and for lesions on the nose, eyelids, or mucous membranes in adults. The beta rays may be applied from a bare glass tube, a bulb, or a flat glazed applicator. The skin about the wart is protected with sheet-lead if the applicator has a surface much larger than the lesion.

The unfiltered bulb as used at the Memorial Hospital has a surface of $\frac{1}{2}$ sq. cm., so that it is applicable to most small warts without the use of sheet-lead. As this bulb contains about 500 millicuries of emanation, treatment of small warts with it is both simple and rapid.

When a flat salt applicator is used the radium content must be multiplied by the fraction of its surface area which is applied to the wart and the resulting figure multiplied by the number of minutes to obtain the actual dose in milligram minutes, viz., half-strength 10 mg. flat applicator 4 sq. cm., wart 1 sq. cm. surface area; 10 mg. × $\frac{1}{4}$ = 2.5 mg., 2.5 mg. × 40 min. = 100 milligram minutes.

Not infrequently it is advantageous to remove larger warts by curettage, fulguration, or electrical desiccation and to treat the sites of their removal subsequently by unfiltered radium in doses of from 60 to 150 millicurie minutes. This combined treatment prevents the recurrences which often follow surgical methods of removal. If preliminary removal is not done, filtered radium tubes having a wall thickness of 0.5 mm. silver are used on these lesions in dental modeling composition at a distance of 3 mm. in doses of from 40 to 60 millicurie hours. On extremely large warts (greater than 2 sq. cm.) small gamma-ray trays may be employed at 1 cm. distance for three fourths of the doses given on page 195. In general, however, warts should be treated with the beta rays whenever feasible, in preference to the gamma rays or *x*-rays of ordinary wavelength.

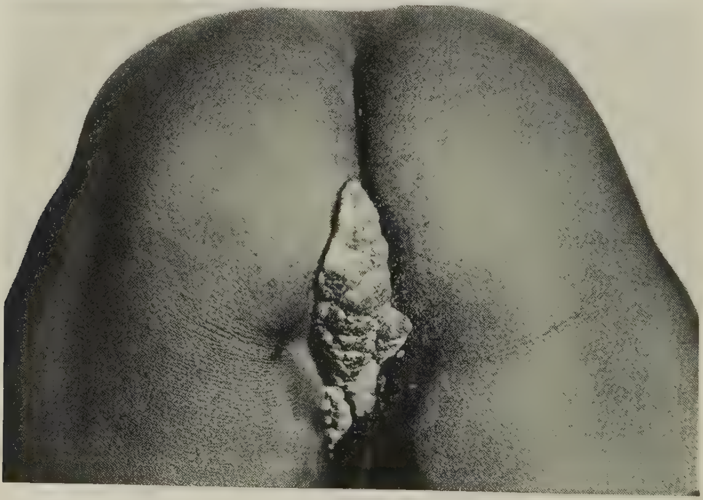

Fig. 818.—Verruca acuminata, large conglomerate mass between legs.

Radium treatment is given foremost consideration because it seems invariably efficacious when properly administered and eradicates the average wart without pain or scarring. The radium reactions necessary to obtain good results in these lesions are so limited that atrophy and telangiectases do not supervene. Changes in the amount of pigmentation in the treated areas in brunettes are sometimes encountered, but these are usually temporary.

2. *Roentgen Rays.*—Excellent results are obtained by roentgen therapy, although the fact that some ordinary warts do not respond to moderate or even large doses makes this method somewhat uncertain. It is, however, more generally available than radium. Preliminary curettage or desiccation prior to the *x*-ray treatment augments the number of cures. Both filtered and unfiltered roentgen rays are used with about equally good results, although the author is inclined to favor filtration. A semi-intensive or sub-

erythema exposure is given to each individual lesion, with proper shielding of the normal skin about it.

With unfiltered technic, the dose ranges from $\frac{3}{4}$ to 2 E. D. For most lesions $\frac{3}{4}$ or 1 E. D. is effective. It is advisable to use such suberythema doses before larger ones are given. For children the dose should be less, being $\frac{1}{2}$ to $\frac{3}{4}$ E. D. In such cases, however, the facility with which radium can be applied makes treatment by it preferable to that by roentgen rays. Warts which have not disappeared under unfiltered *x*-ray treatment may promptly do so under filtered therapy. The results from filtered radiation are occasionally astounding, but greater skill and care are required for it than for administering unfiltered treatment because of the danger of a third degree radiodermatitis developing insidiously beneath the wart. The preliminary erythema, tanning and other changes which usually warn the operator of overdosage are likely to be obscured by the thickness of the wart, so that exposures may be prematurely repeated or too persistently applied, leading to summation of dosage, and ulceration. The first sign of reaction may be a painful or tender puffing or swelling of the otherwise apparently unaffected wart. Whenever secondary infection is pronounced, filtered roentgen treatment should be delayed until this has responded to wet dressings.

The dosage of filtered roentgen rays for warts should be a little less than one erythema exposure. Occasionally it is advisable to give as much as two full erythema exposures to warts on the soles or to large fissured warts in other locations. Sometimes the lesions are so large that this dosage is best distributed by cross-firing.

Following roentgen-ray treatment no change in the wart is usually noted until the second or third week, when it gradually flattens. This flattening continues and generally the wart disappears during the fourth or fifth week after exposure. If at the end of the third week the improvement ceases and during the fourth week the wart tends to regain its original size, a second exposure is usually required to effect a cure.

When there are so many warts that the individual treatment of each lesion with roentgen rays is impossible because of the danger of overlapping and the unreasonable time consumed in administering the treatment, repeated fractional, unfiltered or filtered exposures to the entire involved area, without ordinary shielding, are occasionally effective. The normal skin between the lesions may be protected in a measure by thick bismuth paste. The dosage should always be maintained below an erythema: $\frac{3}{4}$ E. D. every three weeks, or $\frac{1}{2}$ E. D. every two weeks for unfiltered radiation, and $\frac{1}{2}$ E. D. every three weeks for filtered radiation. Neither form of treatment should be continued for more than three or four exposures, during which time close observation for evidences of beginning erythema should be made. Children should receive approximately one half the dosage advocated above. The spontaneous disappearance of multiple warts after treatment limited to one lesion has been occasionally observed. They, however, respond so readily to unfiltered radium that it is preferable to roentgen rays for the particular condition.

3. *Surgical Diathermy.*—Surgical diathermy is often abused in the treatment of warts. It is a good method of removal, and results from its meticulous use parallel those of radiotherapy; but in many instances careless overtreatment by it results in large deep wounds, which heal slowly with scarring or keloid formation.

It is good practice to use the desiccating current with a small cold spark. Following novocaine anesthesia, this spark should be applied only until the lesion becomes luminescent. The moment luminescence occurs, the treatment should be stopped, because, should it proceed further, there will be unwarranted destruction of tissue. The desiccated lesion is then lifted upward by mouse-tooth forceps and removed by small pointed scissors, without bleeding. Emollients such as borated vaselin are applied to keep the scab soft, for when it becomes dry and hard, scarring is enhanced. By such technic the cosmetic results should be excellent.

This method is particularly useful for the removal of large warts prior to the application of roentgen rays and for the treatment of isolated lesions occurring on the scalp, eyelids, nostrils, lips, and tongue, but here, as in other locations, it is often inferior to unfiltered radium. Anesthesia is rarely necessary when the warts are on the scalp. For those located directly over the joints of the fingers and knuckles, radiotherapy is preferred, as the denuded areas following desiccation tend to become secondarily infected.

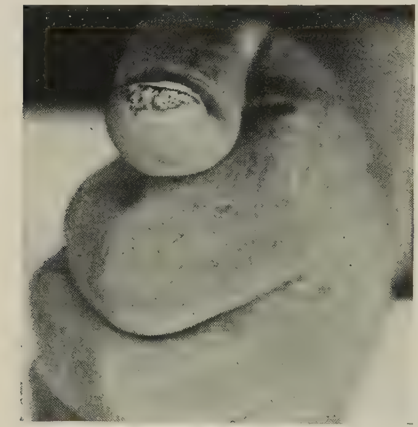

Fig. 819.—Verruca vulgaris beneath thumb nail.

When warts occur beneath the fingernails, the latter should be so trimmed as to expose the warts as much as possible. When completely exposed they are best treated by the beta rays of radium, electrodesiccation or carbon dioxide snow. When they are only partially uncovered, filtered roentgen rays or gamma rays are advocated. The dosage should be subintensive, as larger amounts may cause shedding of the nail from injury to the matrix even though it is shielded as much as possible. (x-Rays should be given in $\frac{3}{4}$ E. D., with 140 kv. peak, 9-inch spark gap, 5 ma., at 10-inch distance, through 3 mm. aluminum for six minutes; radium, 0.5 mm. silver tube, in dental compound, at 5-mm. distance, for 50 millicurie hours; or on large lesions, two tubes, with cross-firing, 30 millicurie hours each.)

Verruca Plana Seu Juvenilis.—This variety of warts can generally be readily treated by desiccation without any anesthesia, a small cold spark being used. The edges of the wart, as well as the central portion, must be destroyed. After desiccation the dried up warts are removed by a dull curet and the bases painted with tincture of iodine. When carefully done, this method is rapid and causes but very slight discomfort. It leaves no scarring, as only the epidermis is desiccated. A similar procedure is to remove the warts by a sharp curet and touch the areas with phenol on the end of a toothpick.

Daily painting with salicylic acid (1 part) in collodion (8 parts) or rubbing with Vleminckx's solution or ointment containing 5 per cent of both salicylic acid and resorcin is generally successful. Radiation is of little value in these cases, although the beta rays are effective in small doses (bare tube, 10 to 25 millicurie minutes, or a half-strength flat salt applicator, in contact, unscreened, for ten minutes on patchy aggregations). The internal administration of mercury is at present popular in the treatment of flat warts. It seems effective in some cases and should be continued for at least six weeks (see page 872.)

Similar warts occur in men on the bearded region. In such cases it is advisable to search the face carefully with a magnifying glass and mark each lesion with an indelible pencil. All the warts are then desiccated, no anesthetic being required. After desiccation, they are removed by a dull curet and the bearded region is treated by x-rays ($\frac{1}{2}$ E. D. to each cheek, overlapping on the chin and neck—with 100 kv., 6 inch spark gap, 3 ma., 12-inch distance, for two minutes, and no filter). The shaving articles should be sterilized as in cases of sycosis vulgaris. In addition, the followin gprescriptions are given. given:

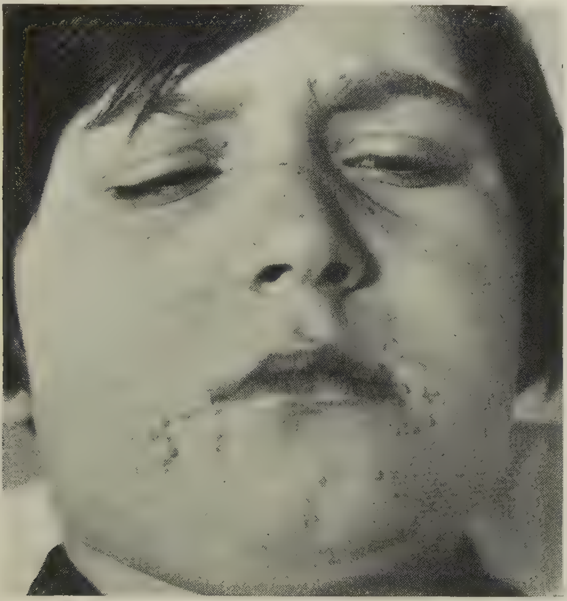

Fig. 820.—Verruca plana juvenilis.

℞.	Bichloride of mercury	gr. iv
	Alcohol	℥iij
	Menthol	gr. ij
	Extract of witch hazel q.s. ad.	℥viij
	Oil of lilac	gtt. iv

M. and S. After-shaving lotion.

℞.	Ammoniated mercury	ʒss
	Cold cream	℥j

M. and S. Apply at bedtime.

Verruca Plantaris.—The treatment of these painful lesions by the older methods was unsatisfactory. Cauterization and surgery were extremely painful and slow procedures, which were accompanied by the danger of infection and often left tender scars. However, by radiotherapy and electrodesiccation, plantar warts may now be easily cured. This fact is not as generally known as it should be. Although all of the lesions may be eradicated by either x-rays, radium, or electrodesiccation, it is preferable to use radiotherapy for the smaller ones and desiccation for the larger.

1. *Roentgen Rays.*—The hyperkeratotic thickening of the lesion should be shaved down with a safety razor blade. As the superficial layers are removed, a dark central horny core is found, which by pressing upon the foot is the usual cause of pain. At times contiguous warts fuse so that what is apparently one wart will have multiple cores. Special attention should be given to paring these horny cores down below the skin level, as pain will thus be relieved and the irradiation will be more effective, for keratin has an absorption coefficient equivalent to aluminum. With a sharp blade, plantar warts can be pared down to a surprising degree without bleeding. Unfiltered x-rays are then applied to each lesion separately through an opening in sheet-lead. When the lesions are conglomerate, however, it is necessary to treat the entire group by one exposure through a large opening in the lead. The opening in the lead shield should not fit the lesion exactly but should expose a small margin of normal skin beyond it, especially in treating small warts, as otherwise the diminutive size of the area will reduce the actual dose so much that it will be ineffectual. Most failures of radiotherapy are due to neglect of these simple precautions.

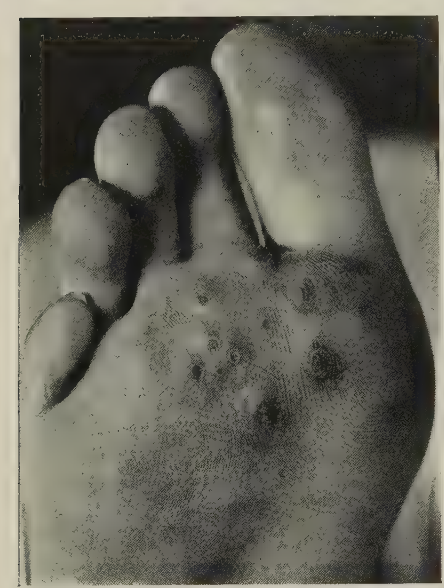

Fig. 821.—Verruca plantaris. Several warts on ball of right foot.

One x-ray treatment is sufficient to cure all small plantar warts and most large ones. The dosage is important and varies somewhat according to the size of the area exposed through the opening in the lead, average doses being 2 E. D. on lesions greater than 1 inch in diameter and $2\frac{1}{4}$ E. D. on those smaller, except when they are less than $\frac{1}{2}$ inch in diameter, in which case $2\frac{1}{2}$ E. D. are given. These doses should be reduced about 50 per cent for children. No caustics should be applied before or after x-ray treatment. If they have been used or the lesion is influenced by any other cause, irradiation should be postponed for a fortnight until the irritation has subsided.

A week or two after the treatment, the lesion may be slightly more sensitive than usual, and examination may show a very slight erythema surrounding it. Soon the sensitiveness ceases and the erythema disappears entirely, while the lesion becomes thinner, and in three to seven weeks is entirely gone. If the wart has not completely disappeared eight weeks after the first treatment, a second may be given in a similar manner and with about the same dosage, and if still unsuccessful, roentgen therapy should be discontinued and the lesion should be thoroughly removed by electrodesiccation.

Filtration is advisable only when preliminary paring down of the hyperkeratosis has been omitted. It is time-consuming, less effective, and more dangerous than the above described technic. The insidious development of third degree radiodermatitis beneath the thick, horny epidermis has already been mentioned. Severe reactions will never be produced by the technic which has been given, but are likely to follow too persistent use of filtered radiation.

2. *Radium.*—After the horny thickening has been pared as described preliminary to *x*-ray treatment, a flat radium salt applicator, unscreened, is employed in contact with the lesion but with shielding of the normal tissues to within a narrow margin of it. The dose should produce a sharp beta-ray reaction (half-strength plaque one to two hours on medium-sized or large areas, and three hours on small areas). The same principles for repetition of treatment as described for unfiltered *x*-rays likewise apply to this technic. The gamma rays may be used without the preliminary paring, but this method has the disadvantages mentioned under filtered roentgen radiation to an even greater extent. Thin screens of 0.01 to 0.1 mm. aluminum are sometimes advised but have no real value.

The results of radium therapy of plantar warts are about the same as those obtained by *x*-rays. With careful use either agent is practically always successful on medium-sized and small lesions and often effectual on large ones.

3. *Surgical Diathermy.*—This method is rapid and effective without causing disability. Its only drawback is the slight danger of infection, the prevention of which will be discussed later. Usually pain is inconsequential, being avoided by good technic.

Regardless of the size of the lesion the procedure is the same. The part is disinfected by tincture of iodine, and strict asepsis is maintained throughout the operation, as in any other form of surgery. After the iodine has dried, a point chosen just outside the wart on the normal skin is anesthetized by freezing with ethyl chloride spray. Novocaine, 1 per cent solution, is injected into this anesthetized spot by means of a 5-cc. Luer syringe with a long thin sharp needle. The injections are continued around the wart until a margin as wide as the diameter of the wart has become insensitive. Then two or three injections from different angles are made into the tissue beneath the wart.

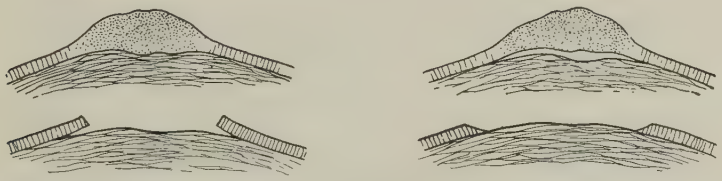

Fig. 822.—Diagrammatic illustration of dead space, which must be avoided in the removal of warts, especially those upon the feet, by surgical diathermy. The wart and epidermis about it are separated from the underlying tissue by steam generated by the intense heat.

The desiccating current is then applied from a needle electrode with a strong spark, which rapidly turns the hyperkeratosis a grayish color, including even a small margin beyond the periphery of the wart. Soon the heat causes a puffing of the grayish area, which then suddenly becomes luminescent. The current should be continued for a few moments until the whole lesion is aglow, which signifies that the dry horny thickening has been desiccated down to the soft tissues and has been separated from the plantar fascia by a space produced by steam, and that it is time to stop the desiccation. The grayish area is then lifted slightly by mouse-tooth forceps and trimmed by small curved, pointed scissors. This exposes a small whitish papillomatous growth on the plantar fascia, from which it is removed by a curet.

A rounded fibrous cavity forms its base and this is lightly desiccated, but the plantar fascia is left intact as it is a barrier against infection. The skin edges about the wound are then removed to avoid any "dead space" which might favor infection (Fig. 822). Usually there is no bleeding.

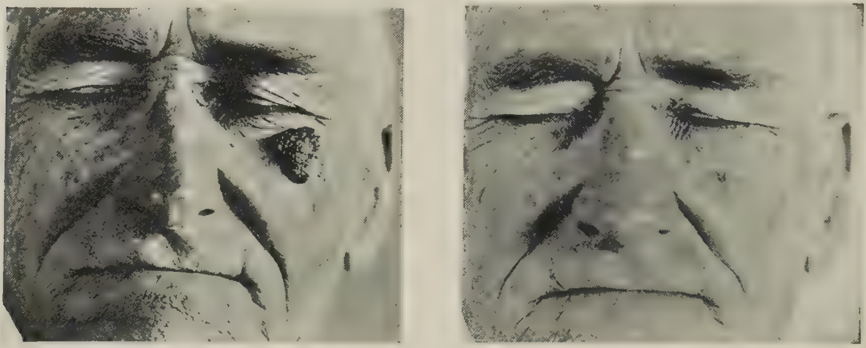

Fig. 823. Fig. 824.

Figs. 823, 824.—Seborrheic wart. Before and after treatment by electrodesiccation.

After the operation, 1 per cent butesin picrate ointment is applied on fairly large pieces of gauze. Dressings are changed daily until the wound heals, which requires three or four weeks. Previous irradiation may delay the healing and otherwise lower the tissue vitality so as to invite infection.

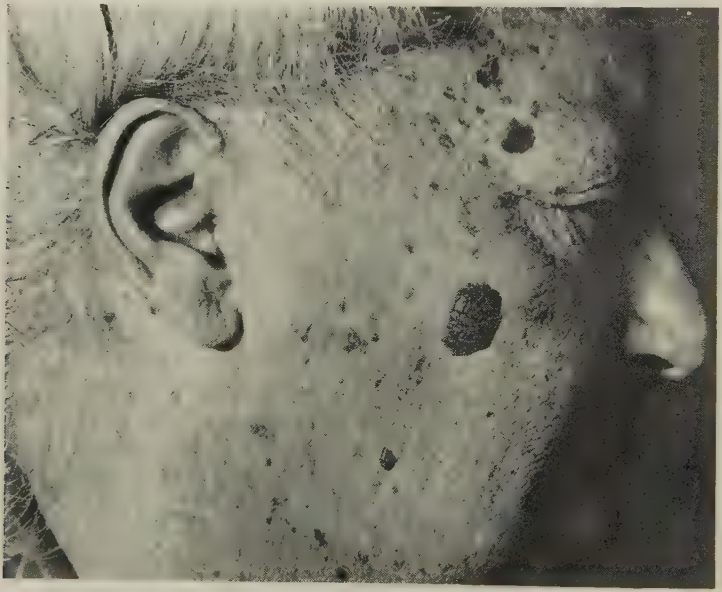

Fig. 825.—Multiple seborrheic warts in an elderly woman.

After-pain is negligible and is controlled by the ointment. The patient may put on his shoe and walk, but he is advised to refrain from unnecessary exercise until the healing is complete.

Verruca Acuminata (*Pointed Condyloma, Venereal Wart*).—Single or multiple small lesions may be desiccated or treated by the galvanocautery under local anesthesia, or curetted and touched with acid. Larger conglomerate masses should be removed by the galvanocautery knife under general anesthesia. After removal, a subintensive dose of x-rays should be given, or the beta rays of radium in doses of 50 to 100 millicurie minutes per square centimeter. It makes little difference whether the x-rays are unfiltered or filtered, but it is important to expose the parts thoroughly and to adjust the anode-skin distance so that all areas receive an equivalent dose. There are on record numerous cases of the cure of large vegetations on the genitals and anus by radiation alone. In most instances x-rays filtered through 3 mm. aluminum were used in from 1 to 2 E. D. While often effectual, this method is slow and uncertain.

Patients should be observed carefully for recurrences, which should be treated persistently by electrodesiccation and a repetition of the irradiation as permissible, until the entire infection is permanently cured. In moist areas about the genitals, cleanliness, and dryness are of the utmost importance (half-strength solution of hydrogen peroxide on cotton applied morning, noon, and night is recommended, followed by dusting powder—iodoform, bismuth formic-iodide, or thymol iodide). When the buttocks are large, this end is achieved better by holding them apart by adhesive strips extending from the anus outward over the loin and the iliac crest. These are applied tightly when the patient is prone.

Seborrheic or Senile Warts.—These occur either on a seborrheic skin or on atrophic skin due to advancing age. They are multiple, slightly raised, light brown or black keratoses, which involve chiefly the face, back, sternal region, and dorsal surface of the hands. These lesions are usually nummular and flat and covered by a greasy crust, which is loosely attached. When the latter is removed, a raw pulpy base is revealed. Seborrheic warts are often associated with itching which may be almost intolerable. Occasionally they are the sites of the development of epithelioma, which is usually composed of basal cells.

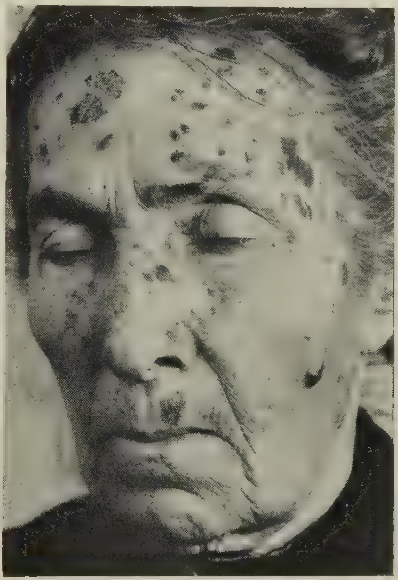

Fig. 826.—Multiple seborrheic warts upon the face, and small epithelioma at center of left cheek.

Treatment.—These warts may be easily removed by curetting, the base being painted by trichloracetic acid to prevent recurrence. If the technic is carefully carried out, the scarring is slight. In prominent locations such as the nose, if scarring is to be completely avoided, the beta rays of radium in doses of from 100 to 150 millicurie minutes, in contact, are used (see page 873). Thick lesions require thorough curetting and when the pulpy element removed by the curet is found to be considerable, radium treatment is better than acid cauterization. The preliminary curetting is of advantage in removing the pulpy mass, which acts as a screen to the rays, and discloses the real extent of the lesion, which could not otherwise be estimated with any degree of accuracy. If there is any doubt as to the diagnosis, a microscopical examination should always be made, for the clinical distinction between thick keratoses and early epithelioma is often not marked.

Some patients have hundreds of these warts on the trunk, and they may itch violently. Unfiltered *x*-ray treatment at times causes their complete disappearance, as well as relief of the itching. The dosage varies somewhat according to the location, but generally is $\frac{1}{2}$ to $\frac{3}{4}$ E. D. repeated in from three to four weeks, if necessary. When the lesions are on the scalp, treatment should be given the accompanying seborrhea.

CORNS (CLAVUS)

These are circumscribed, horny, conical thickenings with the base on the surface and the apex pointing inward pressing upon the subjacent structures. There are two varieties: The hard corns, which occur on the external surfaces of the toes, and the soft corns, which are present between the toes and are softened by the macerating action of the sweat. They arise at sites of friction or pressure, and when these causative factors are removed, they may spontaneously disappear. In the hard corn, the surface is shiny and polished, and when the upper layers are shaved off, in the center there is a core, which is the densest part of the lesion. It is this core which causes the dull, boring or sharp, lancinating pain by pressing on the underlying sensory nerves in the papillary layer.

Treatment.—Although the relief of pressure or friction by corrective footwear is of first importance, this step alone frequently does not cure the corns. Salicylic acid and caustic potash have been favorite methods of treatment, and have often been successful when carefully and diligently used.

℞. Salicylic acid,	
Lactic acid	āā 3 Gm.
Collodion	q.s. ad. 30 "

M. and S. Paint on until corn can be lifted.

Surgical excision is seldom adopted because the resulting wound is over a bony prominence and great care is entailed to prevent infection which may lead to local suppuration, ulceration, or erysipelas. Soaking the feet in hot water and paring the surface by means of a razor or sharp knife, followed by the application of a ring of soft felt wadding around the region of the corn will often bring a good result by relieving the growth of all friction and pressure. This is most likely to be successful if, after the soaking, the central core is loose enough to be extracted by forceps. In these manipulations it is imperative that the instruments employed be aseptic. Although there are numerous methods of treating corns, this annoying common affection is often recalcitrant and recurs or persists from childhood to senescence in spite of desultory or vigorous attempts on the part of the patients or their physicians to give relief.

Pirie has demonstrated the effectiveness of *x*-ray treatment of hard corns. He obtained complete cures in many cases without bad effects by the administration of approximately 2 E. D. to the corn and then shielding to the central core and giving an additional double erythema dose to the core itself. The dose thus given to the core is the equivalent of 4 E. D., which would produce a severe burn on normal skin, but which when localized upon the horny substance of a corn apparently is safe. I have used somewhat smaller doses with excellent results—2 to $2\frac{1}{2}$ E. D., unfiltered, to the whole corn—after preliminary paring of the horny thickness. Several patients with corns of over ten years' duration have been grateful for the cure effected by one treatment. The technic of application and precautions to be observed are the same as those described for the treatment of verruca plantaris.

If the horny covering is first carefully pared away, soft corns as a rule are cured by a single exposure to the beta rays (half-strength plaque, in contact, unscreened, for one hour, or a bare glass tube of radon on the end of a wooden handle moved to and fro over the lesion, giving approximately 300 millicurie minutes per square centimeter). If the corn is thick and in the web between the toes it is usually best treated by an 0.5 mm. silver radium tube for 50 milligram hours.

CALLOSITIES (CALLUS, CALLOSITAS, TYLOSIS)

A callus is a circumscribed hyperkeratosis produced by friction and differs from a corn in that it has no central core and is a more diffuse thickening. Callosities occur usually on areas subjected to long-continued pressure or friction, particularly on parts of the hands and feet, or over bony prominences. They tend to disappear spontaneously when the cause is removed, and for this reason, before treatment of callus of the sole, patients should be examined by an orthopedic surgeon, whose advice will expedite the cure and prevent recurrences. The lesions respond to irradiation, a considerable portion of the dose being absorbed by the thickened epidermis, which acts like a filter. An intensive dose of unfiltered x-rays (1 to $1\frac{1}{2}$ E. D.) is the simplest remedy, but gamma rays are equally satisfactory (half-strength flat salt applicator, screened with 2 mm. brass, in contact, for ten hours, overnight or given in divided doses if desired). Prior to irradiation the callus should be trimmed as thin as possible, and the normal skin about it should be shielded with lead. Strong keratolytics should be avoided for two weeks before radiotherapy is applied.

Proper care of the feet, bathing, drying, and powdering, is important to prevent recurrences. Changing the shoes and stockings two or three times a day is also helpful, especially in persons who stand a great deal, or have weak or deformed feet.

CUTANEOUS HORNS (CORNU CUTANEUM)

Cutaneous horns, sometimes suggesting the horns of animals, are rarely encountered. They are more likely to occur on the scalp and face than in any other location, and sometimes also on the glans penis and scrotum. Usually they are found in elderly persons who have seborrhea or who have been subjected to long-continued exposure to sunlight. True cutaneous horns are medullated, but the term is also loosely applied to nonmedullated horny excrescences. The horns vary in shape and color, being generally brown, and their surfaces may be smooth or rough. The base as a rule is discoid and hyperemic and is subject to carcinomatous degeneration. These lesions are therefore in the precancerous group and should be treated accordingly.

Treatment.—The best method is by excision; but where this is not feasible the galvanocautery is used to remove the horn from its base, which is then heavily irradiated with gamma rays or x-rays. A microscopical examination is always desirable. Caustics should never be applied to the base as they are ineffectual and irritating, and consume time, during which carcinoma may develop.

MOLLUSCUM CONTAGIOSUM (MOLLUSCUM EPITHELIALE, EPITHELIOMA CONTAGIOSUM)

This is a peculiar infectious type of epithelial overgrowth consisting of single or multiple rounded or flat papules, from pinhead to bean size, pearly gray, with a central depression from which a caseous plug, called the molluscum body, may be squeezed. It occurs in birds and animals, as well as in man. The incubation period varies, being a matter of weeks. It is en-

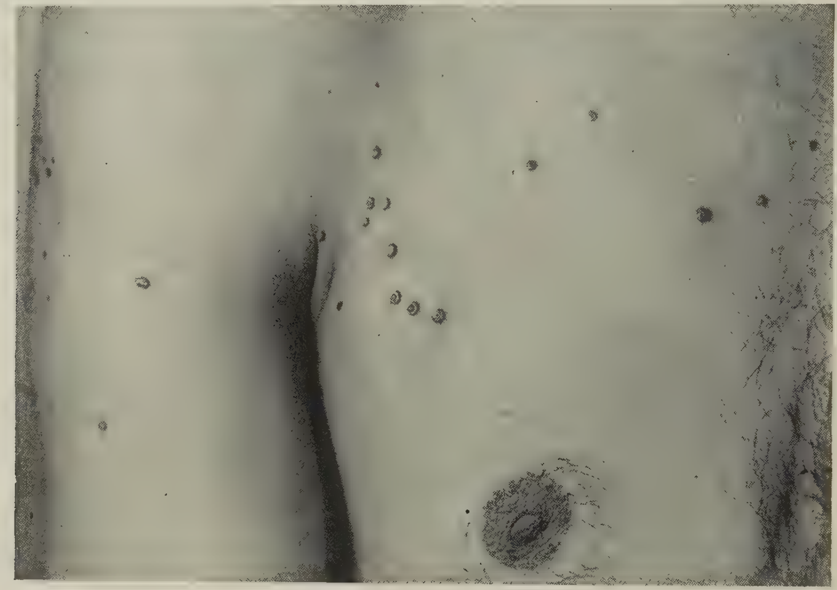

Fig. 827.—Molluscum contagiosum.

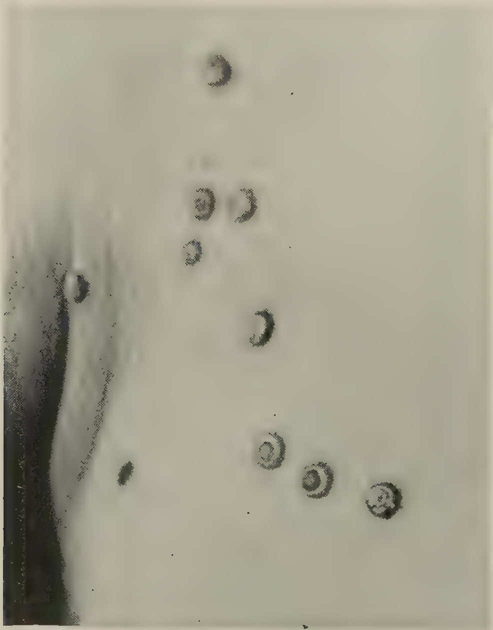

Fig. 828.—Molluscum contagiosum, actual size.

countered chiefly among school children, and among adults who patronize Turkish baths and beauty parlors. In one instance a masseuse spread the disease among several of her clientele although she did not have the disease herself; she used the same jar of cream for all of them and washed her hands before and after each treatment.

The lesions begin as pinhead-sized, scarcely elevated papules with depressed centers caused by a cavity that contains a curdlike substance composed of degenerated epithelial cells and keratin. This material may be squeezed out of the center of the lesion in the form of a plug. If left alone, the lesions generally grow slowly in weeks to the size of a pea. Less often many fresh lesions appear and develop rapidly. The principal sites of involvement are the face, hands, and genitals, but they are commonly found on other parts of the skin and at times are widely distributed.

Treatment.—Molluscum contagiosum is treated simply by the manual expression of the molluscum body from each individual lesion, and by applying carbolic acid to the central cavity with a toothpick. Healing occurs within a week, leaving no scar. The lesions may also be treated by curettage, followed by painting with carbolic acid or iodine. Electrodesiccation may be used but has no advantage; *x*-ray therapy is at times effective, but is slow and frequently disappointing.

ACANTHOSIS NIGRICANS (KERATOSIS NIGRICANS)

This is a rare disease characterized by hyperpigmentation and warty thickenings of the skin of the neck and flexures, which areas, although appearing rough, are velvety to the touch. According to Pollitzer, who first described the disease, the regions affected in their order of frequency are: the axillae, neck, external genitals, groins, face, inner aspects of the thighs, flexor surfaces of the elbows and knees, umbilicus, anus, *et cetera.* Rarely the involvement may be universal. The color of the patches is black or dark brown, exceptionally light brown. The patches are covered with papillomatous growths which may develop into large vegetations, or sessile or pedunculated tumors. Warty lesions may form a collar about the neck, or appear on the mucous membranes, where they are sodden and macerated. Associated atrophy of the hair and nails may be present.

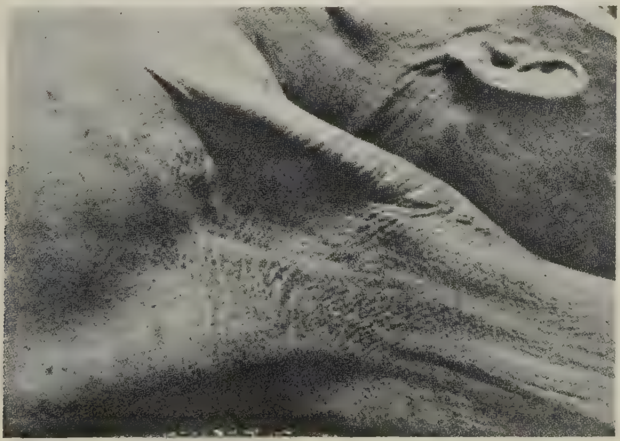

Fig. 829.—Acanthosis nigricans. (Courtesy of Dr. J. H. Swartz.)

The etiology is obscure. A disturbance of the functions of the chromaffin system due to pressure from intra-abdominal tumors has been ascribed a causative rôle. There are two types of acanthosis nigricans: The benign, sometimes called juvenile, and the malignant. The former frequently regresses spontaneously, whereas the latter is associated with malignant abdominal tumors and ends fatally. Swartz and Miller, following a tabulation made by Bogrow, make a comparison of the two types:

Malignant Type	*Benign Type*
1. Coexistence of serious disease of the internal organs (chiefly carcinoma).	1. General health undisturbed or only minor disturbances.
2. Unfavorable outcome as to life.	2. Fatal outcome never recorded.
3. Disease of short duration.	3. Unlimited duration.
4. Intensity and widespread distribution of lesions.	4. Lesions not very prominent and not widespread.
5. Disease remains almost stationary.	5. Disease shows alterations, exacerbations and remissions, sometimes complete disappearance of external manifestations.
6. Disease develops late in life.	6. Disease develops in youthful patients.

Treatment.—In the benign type improvement may be obtained from resorcin and salicylic acid ointments and plasters, curettage, or refrigeration. Wieder and Wise treated the condition with x-rays, which produced some flattening of the papillary hypertrophy, but at the same time caused a prompt and disproportionate increase in the pigmentation, for which reason the treatments were stopped. Arndt and Petrini recommend roentgen therapy.

Darier's Disease (Keratosis Follicularis, Psorospermosis, Keratosis Vegetans)

Darier's disease is a rare condition of obscure origin, and causes dirty warty, papular excrescences, which tend to coalesce into patches on symmetrical areas of the face, trunk, and flexures of the extremities. The early lesions are small firm, follicular papules, almost the color of normal skin. Each of these soon becomes covered with a greasy, gray, brown or black crust, which fits into a small concavity in the summit of the papule. As the lesions grow older, their color becomes darker. In the course of years the papules grow and may fuse to form papillomatous and vegetating malodorous growths. These are fissured and superficially ulcerated and covered with an offensive purulent and sanguineous exudate. The neck and shoulders, the face, extremities, the front of the chest, and the midline of the back are sites of predilection for the disease, but as the eruption spreads, the entire trunk, buttocks, genitals, and other parts of the skin may be involved. Usually the eruption is symmetrical and widespread. The vegetations occur chiefly in the axillae, gluteal crease, groins, and behind the ears. The scalp is generally covered with greasy crusts. Lesions on the face are particularly severe about the nose. The lips may be crusted, fissured, swollen, and superficially ulcerated and there may be a patchy keratosis with superficial ulcerations on the dorsum of the tongue. A general horny thickening of the palms and soles may be present due to innumerable closely set small papules. The nails show subungual hyperkeratosis and various malformations.

The patient usually suffers from severe itching and discomfort, owing to the skin ulcerations, which cause pain, bleed readily, and have an offensive odor.

Treatment.—Treatment with keratolytics may give slight temporary relief, but the disease is chronic and intractable. The best results are ob-

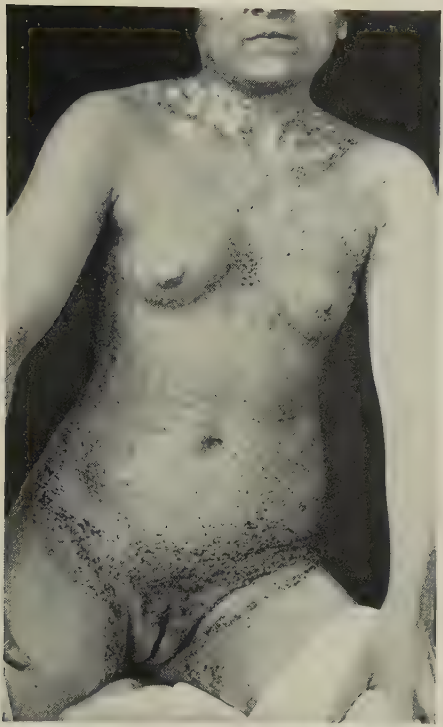

Fig. 830.—Darier's disease. Note symmetrical involvement, and the scars on the neck which were caused by radium treatment.

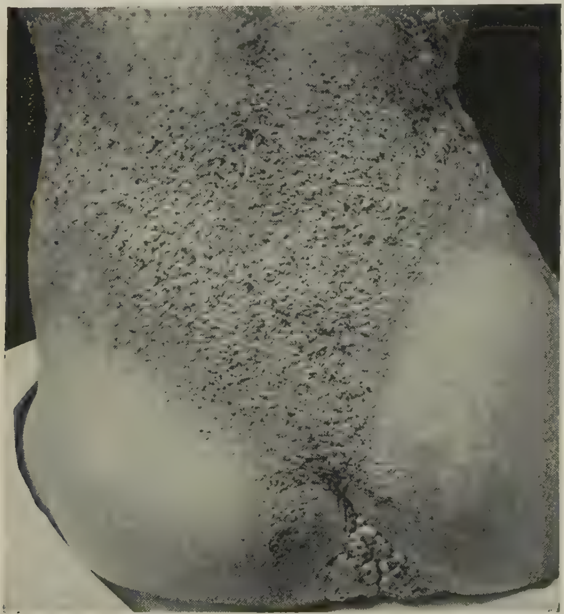

Fig. 831.—Darier's disease, showing vegetating lesions between the buttocks.

tained by roentgen therapy, which gradually relieves the itching and discomfort. The dosage should be fractional and should not be excessive, because the eruption prevents the perception of an erythema and this may easily lead to a severe x-ray burn.

GONORRHEAL KERATOSIS (KERATODERMIA BLENORRHAGICA)

This is a rare skin condition which occurs a few weeks or months after infection with gonorrhea, in association with gonococcus bacteriemia, constitutional disturbances, and arthritis. The keratosis may appear in small patches which begin as reddish or crusted lesions, or may be a diffuse thickening of the horny layer. Favorite sites of involvement are the palms and soles, elbows and knees, although the affection may at times have a widespread distribution. Ultimately the crusts and horny masses tend to become detached from the surface and are followed by hyperpigmented spots. Examination of the lesions bacteriologically has failed to demonstrate gonococci. Histologically, there is an acanthosis or a hyperkeratosis, and in the cutis the vessels are dilated and surrounded by accumulations of lymphocytes, polymorphonuclears, plasma cells, and a few eosinophiles.

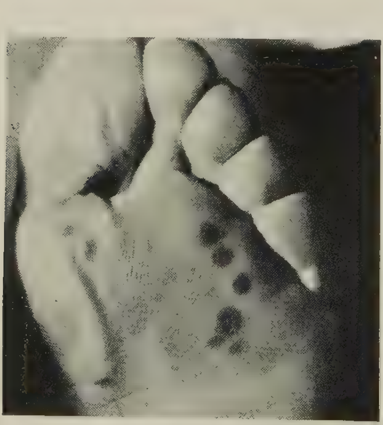

Fig. 832.—Gonorrheal keratoses. (Courtesy of Dr. A. M. Davidson, Winnipeg, Canada.)

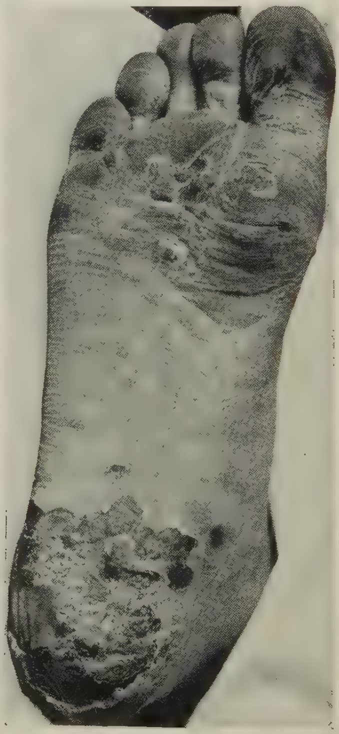

Fig. 833.—Gonorrheal keratodermia. (Courtesy of Dr. A. M. Davidson, Winnipeg, Canada.)

Treatment is directed against gonorrhea, and improvement in the skin runs parallel with progress in the treatment of the bacteriemia and the involvement of the genito-urinary tract. Gonococcus vaccine has been reported as beneficial.

KERATODERMIA

A thickening of the horny layer, especially of the palms and soles, occurs in a number of diseases. Congenital varieties are present in ichthyosis, keratoma palmaris et plantaris hereditaria, and the verrucous nevi. Idiopathic varieties are found in chronic eczema, psoriasis, pityriasis rubra pilaris, keratosis follicularis, and porokeratosis. The condition may develop in the course of syphilis, tuberculosis, ringworm, and radiodermatitis, or be caused by arsenic and occupational irritants.

Treatment.—The treatment depends upon the cause, but generally is difficult. In cases of radiodermatitis, surgical excision and skin grafting are advisable. In other cases, temporary improvement is usually attainable by the use of *x*-rays and keratolytics, but permanent relief is uncommon. Roentgen therapy is applied in fractional, filtered exposures. The dose should be kept well below an erythema. As all effective keratolytics are irritating, there is some danger in combining their use with *x*-ray therapy. However, the clinical results obtained by an effective blending of medicinal keratolytics with roentgen therapy are superior to those derived from uncombined treatment. The strength of the local application and the size of the dose of *x*-rays have a reciprocal relation. If the one is large, the other must be small. This method of treatment must be applied with caution. As a general rule, it is safe to begin with 3 to 5 per cent salicylic acid ointment and $\frac{1}{6}$ filtered erythema dose. Such *x*-ray treatments should be repeated at weekly intervals in a course of six applications, and given again after a rest interval of one month. With extreme care the medicinal applications may be gradually increased in strength according to the tolerance of the patient. In cases resistant to the above methods, the skin may be softened by liquor potassii and then curetted, or the horny layer may be removed by electrodesiccation.

BENIGN CYSTIC EPITHELIOMA (EPITHELIOMA ADENOIDES CYSTICUM, ACANTHOMA ADENOIDES CYSTICUM, TRICHO-EPITHELIOMA PAPULOSUM MULTIPLEX)

This affection is characterized by multiple small rounded, smooth, shiny, firm, circumscribed papules, which occur mostly on the face, particularly about the eyelids, and scalp, neck, and chest. The individual lesions are pinhead sized or a trifle larger, flesh colored or slightly reddish or yellowish. They are occasionally depressed in the center, or coalescent. However, they are, as a rule, discrete although close to one another in a group. On the face they are often symmetrical, and they are more common in females during the thirties or forties. Usually the lesions are stationary or slowly progressive, exhibiting no serious tendency to malignancy. Sometimes their benignity is more fictitious than real, for they become ulcerated and locally malignant, in which case the tumors become larger and solid, and resemble the button type or rodent ulcer type of basal-cell epithelioma. The lesions may be somewhat translucent and simulate vesicles or milia. The cause is unknown; but a hereditary tendency has been noted. According to McCafferty, there is much evidence in favor of these tumors having a manifold origin—some coming from the epidermis, others from the hair papillae or root sheath and still others possibly from embryonal "cell rests." Their histology is variable, but usually there are long slender epithelial projections downward from the basal-cell layer, enclosing an imperfect cellular structure containing colloid and corneous cysts.

Treatment.—The methods of treatment that are most satisfactory are cauterization, desiccation with the high frequency current, or curettage followed by the application of trichloracetic acid. In accessible locations the larger lesions may be treated by *x*-rays. Radium has also been used with good results.

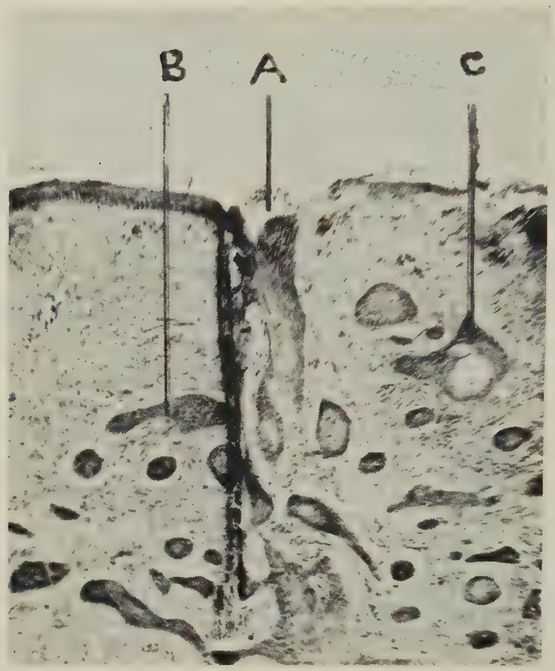

Fig. 834.—Tricho-epithelioma. Showing cell nests coming from the hair follicle. Also shows the cystic degeneration in the centers of some of the nests. Some of these nests suggest dilated sweat ducts, hence the confusion with syringocystadenoma. A, Hair follicle. B, Cell nest coming from the hair follicle. C, Cystic degeneration in the center of the cell nest. (Courtesy of Dr. Lawrence K. McCafferty.)

ADENOMA OF THE SEBACEOUS GLANDS

Sebaceous cysts, or atheromata, occur chiefly on the scalp, back, and scrotum. They are commonly fluctuant, tense swellings, the size of marbles, attached to the normal skin above them by the remains of the expanded gland duct, the opening of which shows at a central point on the surface as a comedo. The cheesy contents are formed of epithelial débris and sebaceous material. Frequently these cysts become infected, after which event they are more firmly adherent to surrounding structures and more difficult to enucleate. Sebaceous cysts rarely become cancerous in the course of time.

The **treatment** is by surgical excision, care being exercised to remove the sac completely.

Adenoma sebaceum has been described on page 856 (chapter on Diseases of Congenital Origin).

SYRINGOCYSTADENOMA

This affection clinically consists of small translucent nodules which resemble those of benign cystic epithelioma, being, however, slightly yellowish or pinkish, soft and compressible. They occur chiefly on the shoulders, upper arms and chest, develop slowly, and persist indefinitely without symptoms. The growths are probably of congenital origin, from the epithelium of the sweat duct or coil. They are histologically distinct from adenoma sebaceum, multiple benign cystic epithelioma and tricho-epithelioma, with which they have been confused at times. Microscopically the lesions are composed of dilated tubular structures and cysts of epithelium resembling those of the sudoriparous tubules. McCafferty suggests that, as the sweat ducts develop, for some unknown reason they never reach the lower part to form a coil gland, but are abruptly stopped in their development and later produce cystic changes which in turn constitute the tumor. The tumors probably do not develop from normal sweat ducts but arise from embryonic "rests."

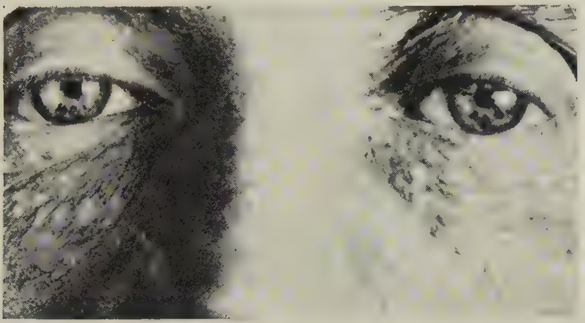

Fig. 835.—Syringocystadenoma beneath the eyes; cannot be differentiated from multiple benign cystic epithelioma except microscopically. (Courtesy of Dr. Lawrence K. McCafferty.)

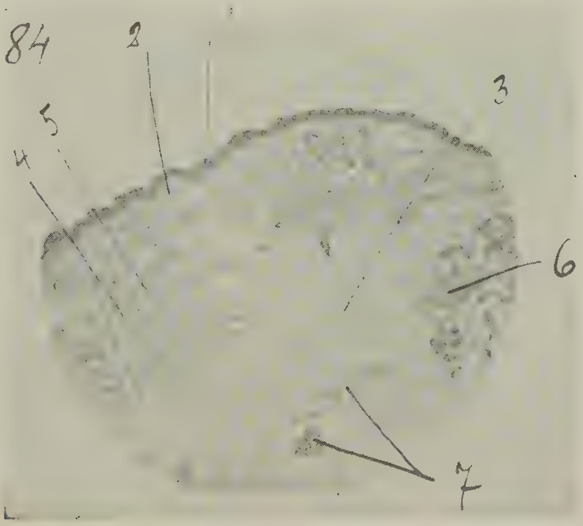

Fig. 836.—Syringocystadenoma. This shows the tumor in the middle of the section characterized by numerous sweat ducts and dilated sweat ducts of syringoma-like form. The sweat glands may be seen in the lower part of the section; there being apparently no connection regarding the origin of the sweat ducts above. 1. Epidermis. 2. Corium. 3. Midcutis. 4. Dilated sweat duct with débris. 5. Numerous small sweat ducts which are larger than normal. 6. Sebaceous gland. 7. Sweat gland. (Courtesy of Dr. Lawrence K. McCafferty.)

Treatment.—Roentgenotherapy is the most satisfactory method of causing involution. The dosage should be fractional. Ormsby, and MacKee have reported cures, six to ten weekly exposures generally being necessary.

CORIUM

FIBROMA (FIBROMA MOLLUSCUM, MOLLUSCUM FIBROSUM, MOLLUSCUM PENDULUM)

These are benign connective tissue growths which occur clinically as single or multiple flat, sessile or pedunculated lesions of a pinkish or ivory color, and which may be soft or hard to the touch. The majority of cutaneous fibromas are now known to originate in the perineurium or in the interstitial tissue of the peripheral nerves, and are therefore called "neurofibromas." The minority develop from the connective tissue fibers of the corium, from which source keloids also come.

Neurofibromas are of two varieties: (1) Superficial tumors in the derma or just beneath it, single or multiple (fibroma molluscum), and (2) subcutaneous or deeper tumors attached to the peripheral portions of nerve trunks, single or multiple, but more cellular and more dangerous than the first variety.

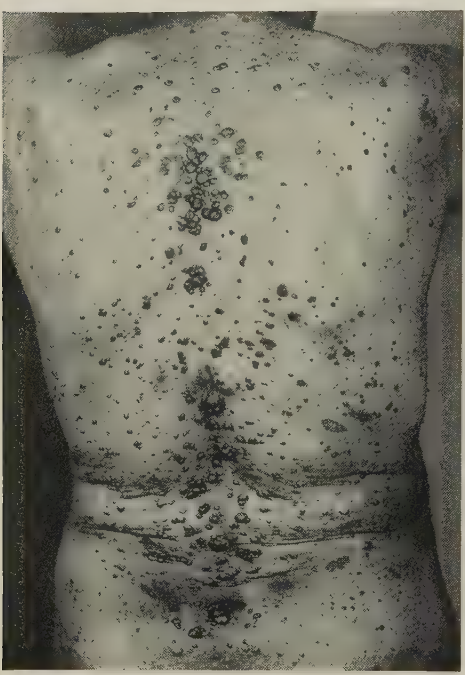

Fig. 837.—Von Recklinghausen's disease. Note pigmented macules on lower back.

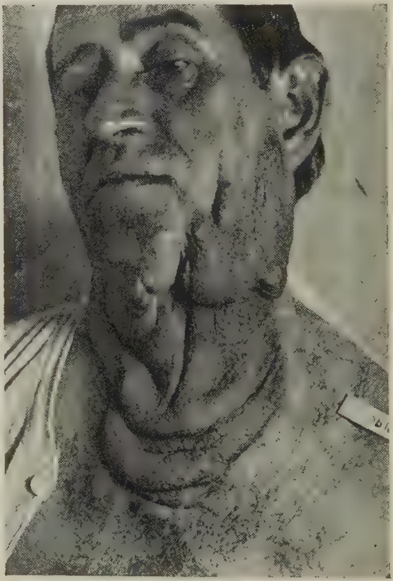

Fig. 838.—Fibroma pendulum (molluscum fibrosum). (Courtesy of Dr. Hermann Feit.)

The superficial cutaneous neurofibromas may be of pinhead size, or pendulous, flabby masses weighing several pounds. Some of the small soft tumors can be invaginated through a ring in the skin by pressure with the finger, but spring back when released. Often a single lesion brings the patient for advice, but upon examination many others are found. They may be very numerous (von Recklinghausen's disease) and widely distributed, without subjective symptoms. Pigmentation of the overlying skin is common; in fact, the disease may begin as a café-au-lait spot or be associated with freckling or general hyperpigmentation. Although multiple fibromata are probably of congenital origin and often hereditary, they do not usually appear until childhood, and the onset may be delayed until old age. Frequently the lesions are accompanied by other anomalies, particularly nevi and mental stigmata. In a case reported by Potter and McWhorter the patient died from disseminated sarcomas which arose from the degeneration of a fibroma. There is no effective treatment of tumors which have grown to an inconvenient size except surgical removal. Single cutaneous neurofibromas are often small hard, painful, sharply defined nodules, of slow growth, resembling the firmer lesions of von Recklinghausen's disease. They can usually be excised, without recurrence.

Neurofibromas of the deeper nerve trunks occur as nodules along the peripheral nerves. "In the simplest form the tumor is a firm movable mass lying in the subcutaneous tissue, well circumscribed, of moderate dimensions, slow growth, and often permitting successful excision. Very often, however, the single subcutaneous tumor is associated with other growths which appear later in the course of the same nerve trunk. Or the single superficial tumor is followed after excision by another growth at or near the original site. The subcutaneous and intermuscular regions of the arm, leg, popliteal space, neck, or back are favorable sites of such multiple tumors, with recurrence after operation."[1]

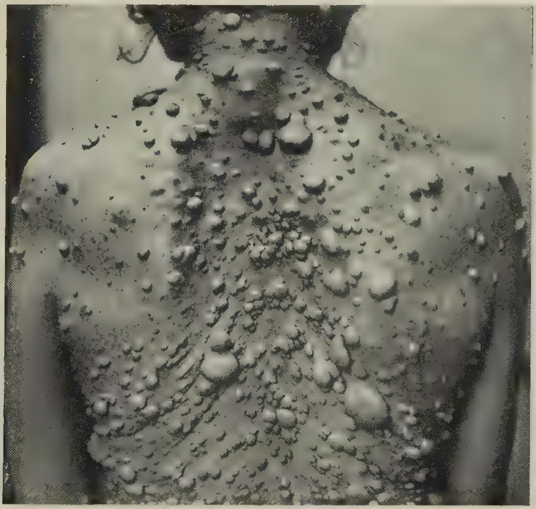

Fig. 839.—Advanced case of von Recklinghausen's disease, showing pendulous tumors. (Courtesy of Dr. H. W. Barber, London, England.)

KELOID (KELOID OF ALIBERT, CHELOID, CHELOMA, KELOMA)

Keloids are firm, irregularly shaped elevations of the skin due to a slow new growth of fibrocellular tissue in the corium. Two varieties are sometimes recognized, one of spontaneous origin, and another which originates in scar tissue; but the existence of the first is doubtful. The fibrous growth usually arises as the result of traumatism and tends to spread beyond the limits of the original injury, sending out claw-like prolongations. The overlying epidermis is smooth, glossy, and thinned from pressure. Early, growing lesions are pinkish and tender, and have the consistency of rubber. They are often surrounded by an erythematous halo and are themselves usually telangiectatic.

[1] Ewing, J.: Neoplastic Diseases, Ed. 3, Phila., W. B. Saunders Co., 1928, p. 167.

In the course of time keloids generally become brown, hypesthetic, hard, and stationary; but they rarely involute spontaneously. They are often multiple and vary in size and number. I counted over fifty on a man's back where pinch grafts had been removed. Sometimes keloids are tiny as pinheads and again one may be as large as an orange. Those which follow burns and scalds are the most extensive. Over the joints and about the mouth and eyes they may form cord-like bands, which produce disfigurement and contractures. Lesions are often linear and the surface may be larger than the base so that the edges are overhanging. The most common location is on the sternal region, but keloids also occur frequently on the face, neck, ears, axillae, and extremities, as well as other parts of the skin, and rarely on the mucous membranes. They are much more common and grow to larger dimensions in negroes than in other races.

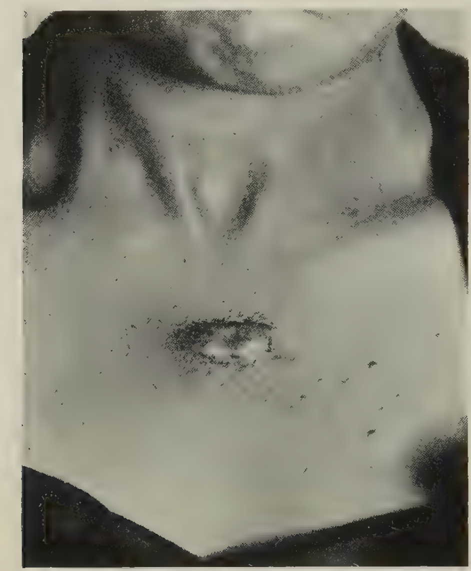

Fig. 840.—Small keloid in common location.

Treatment of young, growing, erythematous keloids is generally satisfactory. As, in the course of time, the lesions become stationary, less vascular and firmer, they become radioresistant and therapy is less successful. Large old hard keloids are recalcitrant to any measure short of excision.

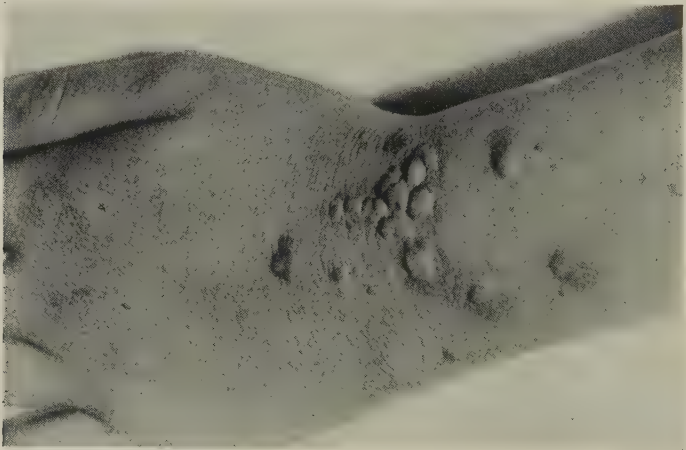

Fig. 841.—Multiple keloids which developed after the removal of warts by the application of an acid.

Surgery alone does not give good results as afterward the lesions usually recur. Nevertheless, when surgical removal is combined with radiotherapy it is the best method of treatment for the radioresistant varieties. Patients who have hard keloids, especially of long duration, should have these lesions treated by excision, and upon the slightest sign of recurrence the newly formed keloid should be dissipated by irradiation.

Excision is performed with every endeavor to obtain primary union and a good cosmetic result. A wide excision is not necessary as any small remnants of the keloid will succumb to the radiation. The wound should be closed with as few stitches as possible because of the likelihood of development of additional keloids at the stitch-holes. Whenever possible small wounds should be closed by skin clips and wounds too large to be sutured should be grafted. Dorrance and Bransfield advise that the edges be undermined and approximated by mattress sutures with the use of buttons, which obliterate all dead space and thus prevent the formation of blood clots. "Eversion of the edges places subcutaneous tissue next to subcutaneous tissue and, as a result, less fibrous tissue is formed. Overcorrected tissue after a comparatively short time will become flat and the scar will be scarcely discernible." The cosmetic results of this combined treatment for large, hard inveterate keloids are superior to those from radiotherapy alone.

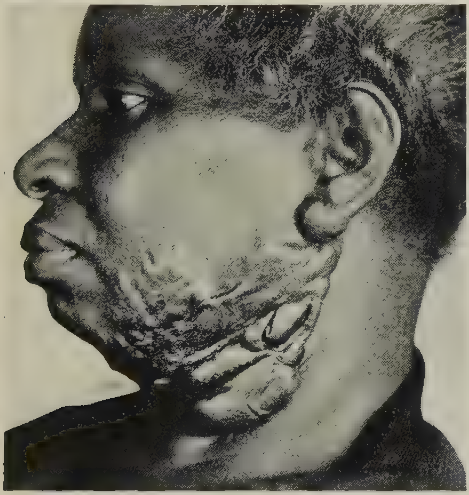

Fig. 842.—Large keloid of apparently spontaneous origin in a negress.

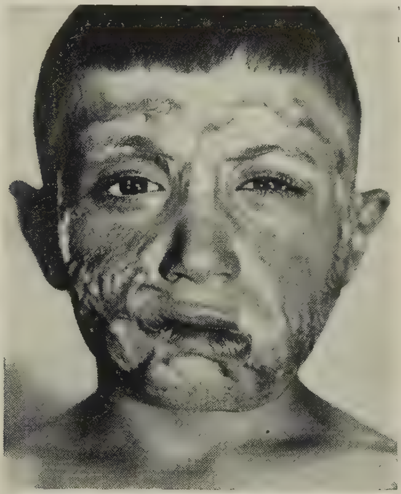

Fig. 843.—Keloidal scarring following a burn.

Preferably a suberythema dose of heavily filtered x-rays or radium is given prior to excision. This has an inhibitory action on the growth and is given as a prophylactic against recurrence. After the operation, the wound is observed carefully for evidence of recurrence, which shows as a cordlike thickening of the edges of the wound. If there is a recurrence, it consists of young actively growing connective tissue cells which are radiosensitive. It should receive the same radiotherapy as an untreated keloid, namely, suberythema exposures of penetrating radiation.

Radiotherapy is based upon the selective action of radiation on the young, growing, connective tissue cells which form the keloid. It is most successful when applied in the early stages of the disease, gamma rays or hard x-rays in suberythema doses being used. Small young keloids often disappear after one exposure. Larger and older lesions, being less radiosensitive, require persistent treatment over long periods, but the dosage should always remain suberythema. Better results are obtained in thin flat lesions which may be spread over an entire region than in discrete thick tumors though of limited breadth. The latter variety, unless very immature, should not be treated by radiation alone, but should be first excised. Likewise, keloidal bands, and vicious cicatrices are usually radiosensitive only when of less than one or two years' duration. Attempts to cure old hard keloids and keloidal bands solely by radiotherapy are almost certain to lead to disfigurement. The cells of which such tumors are composed are resistant to radiation, and doses of a character destructive to the normal tissues about the lesion must be used to influence it.

Sequelae to be avoided are depigmentation, persistent hyperpigmentation, telangiectasia, atrophy, and ulceration. Pigmentary changes in dark skins are sometimes impossible to guard against, even with small doses, but as the dosage is increased to effective amounts ($\frac{3}{4}$ E. D.) they are more likely to ensue. Hyperpigmentation is most common. It is doubtful if depigmentation ever occurs from doses within the therapeutic range (suberythema). Depigmentation is almost certain to follow excessive doses which produce an erythema, and it supervenes just as frequently after radium as after *x*-rays but is possibly less likely after hard than after soft radiation. Telangiectasia and atrophy are in the same category and are probably always preceded by an erythema when caused by radiotherapy.

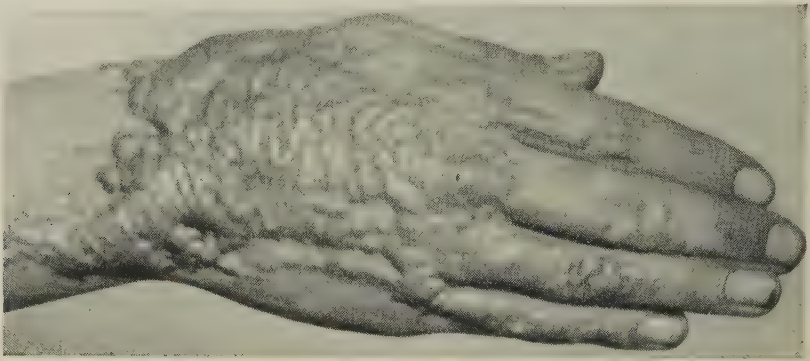

Fig. 844.—Keloidal scarring of hand following a burn. (Courtesy of Dr. Hamnett A. Dixon, Toronto, Ont.)

It must be remembered that the epidermis over most keloids is mildly atrophic due to pressure from beneath, and that in addition to the erythematous halo which usually surrounds early lesions there are dilated vessels coursing over them. Hyper- and de-pigmentation are also observed in many keloids following scalds and burns which have never been irradiated. These skin changes—atrophy, erythema, telangiectasia, hyper- and de-pigmentation—should not be blamed on radiotherapy unless they were not present before the exposure and became manifest to a marked degree in due course of time after it, and, additionally, unless the dosage was excessive.

Ulceration is likewise common in keloids which have not been irradiated. The thinned epidermis over the growths is sensitive to trauma which may arise from scratching or blows. Fissures occur in the keloidal bands over the joints and become ulcers. In the radiotherapy of keloids ulcers are caused only by soft radiation and are absolutely avoidable. Easily absorbable rays have a caustic action which is unwarranted in the treatment of keloids.

The *technic* of radiotherapy is influenced by the size, consistency, location, and age of the keloid, as well as by the patient's age and texture of skin.

Small Keloids.—The normal skin about the keloid should be shielded carefully to its edge. Failure to take this precaution may lead to disfigurement of the skin about the keloid by pigmentation or more objectionable radiation sequelae. Unfiltered *x*-rays are suitable for the treatment of lesions less than 5 mm. thick, and for greater thicknesses, *x*-rays filtered through 3 mm. of aluminum, or gamma rays are used. In general, the harder the radiation, the better are the cosmetic results. This rule is specially important when the keloid is hard, old, or conspicuously located. The dosage should be suberythema.

Unfiltered x-rays: 100 kv., 6-inch spark gap, 3 ma., 8-inch distance. Exposure time, one minute, thirty seconds; repeated at intervals of three to four weeks.

Filtered x-rays: 136 kv., 9-inch spark gap, 5 ma., 10-inch distance. Exposure time, five minutes; repeated at intervals of four to five weeks.

Gamma rays: Removable platinum implants, 3 mc. each, 1.5 to 2 cm. equidistant from one another, 0.5 to 1 cm. depth, taken out after three to six days. Flat half-strength 10 mg. radium applicator, screened with 2 mm. brass, in contact, eight to twelve hours. Treatment repeated at intervals of five weeks.

For small linear keloids, a silver tube containing salt or emanation, in contact, 3 to 4 milligram hours. Several tubes laid end to end when the keloid is long. Treatments repeated at intervals of five weeks.

Large Keloids.—These may be divided into two groups: (1) Thick localized lesions, and (2) extensive lesions with relatively little thickening. The first variety is rarely seen except in negroes and arises idiopathically or from some slight local infection or trauma. Some of these lesions are a couple of inches thick and several inches in length and breadth. They should be treated by a combination of excision and radiotherapy. The keloids of the second variety generally follow burns or scalds and are very disfiguring. Whole regions are affected, the cord-like bands leading to contractures which distort the parts and limit their motions. The deformity when on the face is most pronounced, especially about the eyes where there is ectropion, and about the mouth. The thickening is not uniform, but occurs in patches, the intervening areas being atrophic scars or normal skin. These lesions are best treated symptomatically. *x*-Rays, radium, ultraviolet light, and the galvanocautery are the important remedies and each has its own indications.

x-Rays are used first, but generally not as in other varieties of keloids. Fractional exposures ($\frac{1}{4}$ E. D.) of *x*-rays, filtered through 3 mm. of aluminum, are given weekly except in children, for whom the dose is halved. Shielding is difficult and unnecessary except for the eyes, scalp, thyroid or testes. This type of roentgen therapy should be continued conservatively with intermissions until the thickening is reduced as far as possible, which usually takes several months. Radium is applied only to hard lumps or cords which have not responded to moderate *x*-ray therapy. The gamma rays are used, lumps being treated by 2 mm. brass trays applied at 1 cm. distance (see chapter on Radium, page 200), and cords or bands by a brass tube or a tandem of tubes at 1 cm. distance for 100 to 125 milligram hours per tube, or by one or two removable platinum implants. When such lesions are resistant to radium and are disfiguring they are best eradicated by using the galvanocautery.

Ultraviolet therapy is used to improve the appearance of the skin after full benefits have been derived from the preceding methods. The results are also gratifying when this agent is employed on small young keloids. Exposures should be filtered through blue cobalt glass and should provoke a first or second degree reaction, which will cause local hyperemia and epidermal exfoliation. The hyperemia which lasts several days apparently leads to absorption of remnants of the keloid, and the exfoliation tends to produce uniform texture and color of the region.

Other methods of treatment are refrigeration, electrolysis, iontophoresis, and digestion. Any procedure which involves traumatism is objectionable as it is likely to be followed by a recurrence larger than the original growth. Iontophoresis with iodine and other substances is credited in the literature with some beneficial influence but even if accepted as claimed it cannot be recommended to those who have facilities for *x*-ray and radium therapy. The same statement is applicable to treatment by digestion with pepsin and other ferments.

Preventive treatment is a misleading term which has no foundation. There is no possible way to prevent the formation of keloids except to avoid trauma. Some individuals have a keloidal tendency and develop lesions so frequently and readily that a spontaneous origin has been assigned to some keloids. Neither *x*-rays nor radium is preventive, keloids sometimes occurring in the scarring of radiodermatitis. However, these agents form the only means of removal that guarantees against recurrence.

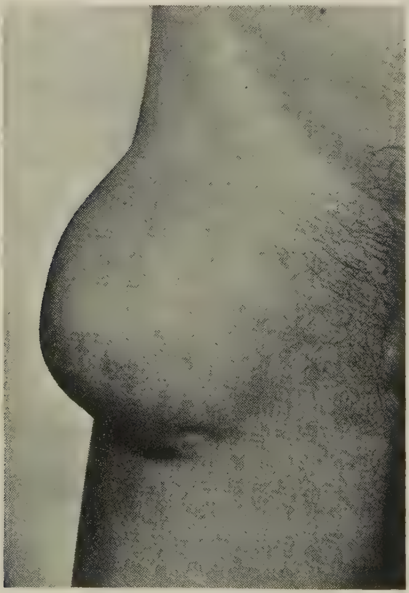

Fig. 845.—Lipoma.

Lipoma

Lipomas are tumors composed of fat tissue and are as a rule subcutaneous, being most common on the trunk. They are single or multiple, small or large, lobulated, compressible growths, over which the skin upon traction often becomes dimpled although otherwise unchanged. They vary as to amount of fibrous and vascular constituents and at times undergo spontaneous atrophy, calcification, liquefaction, or xanthomatous changes. They usually stop growing after attaining a certain size and remain stationary indefinitely. Large tumors have been described on the scrotum and labia, and more diffuse varieties of lipomatosis, which are not true lipomas, are localized on the neck or hips, or are generalized as in adiposis dolorosa. Lipomas are differentiated from other conditions by their consistency, slow growth, lobulation, and mobility.

Treatment.—Lipomas are best left untreated unless they are large enough to be very objectionable, when they should be thoroughly removed by surgical excision. They never become malignant and their removal is likely to produce more scarring and inconvenience than is warranted.

NEUROMA

A neuroma is a tumor composed of nonmedullated nerve fibers and connective tissue, being akin to the neurofibromas, but of a more definitely neural character, and seems to be chiefly derived from the sympathetic system. It originates from the neurilemma and forms a slowly growing, almost stationary, tender reddish or bluish growth in the derma. Agonizing, paroxysmal, and radiating pain may occur. A patient whom I treated had one such tumor on the posterior aspect of the thigh which caused him intense paroxysms of pain. It completely disappeared, as did the symptoms, after an intensive dose of gamma rays. However, most of the patients in other cases reported have been treated surgically.

LEIOMYOMA

Leiomyomas are smooth muscle tumors, which are conveniently separated into two groups: (1) Multiple cutaneous leiomyomas, which arise from the m. arrectores pilorum and (2) subcutaneous leiomyoma, which is often solitary and deep, and usually arises from the m. dartos. The latter are chiefly the concern of the surgeon. They are circumscribed, sensitive, or painful growths, which do not recur after excision. They are seen in the region of the nipples, on the scrotum, or on the external genitalia of the female, places markedly rich in smooth musculature. Varieties have also been described which arise from the tunica media of the blood vessels and from embryonic muscle cell rests. Those of the multiple cutaneous variety are from pinhead- to pea-sized brownish papular lesions which occur principally on the

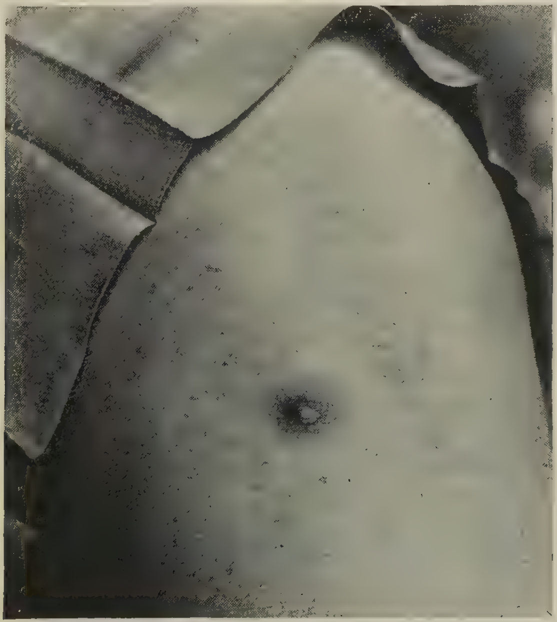

Fig. 846.—Leiomyoma on the knee. Moderate tenderness but no pain. (Courtesy of Dr. James H. Mitchell.)

face, neck, and extensor surfaces of the extremities. They have a tendency to multiply and spread for years, often blend into plaques on which are several irregular elevations, and are usually painful in degree according to the size of the tumor. The diagnosis is made by microscopical observations, which show a nodular growth consisting of smooth muscle cells situated in the corium. Young growing tumors are radiosensitive. Electrolysis or cauterization is used on others, unless their size warrants excision.

Osteoma Cutis

Cutaneous osteomas or bone deposits are rarely encountered. Apparently primary development of bone in the skin without previous lesions has been reported by Coleman, Taylor, and McKenna, whose cases are reviewed in the reports of Strassberg and Becker. Carl described a chondro-osteoma in the skin of a child. Hopkins called attention to the possibility of these lesions arising from embryonal rests. He reported a case of miliary osteomas of the skin and reviewed the development of bone in epithelial tumors, where it is evidently preceded by calcification and is a metaplasia; and in areas of inflammation or tissue degeneration, in which the process is also metaplastic. Excision is the only successful method of treatment for osteoma of the skin.

Pseudoxanthoma Elasticum (Elastic Tissue Tumor, Xanthoma Elasticum)

This is a very rare affection characterized by multiple pinhead- to pea-sized clustered, discrete or coalescent yellowish soft subepidermal nodules which show upon microscopical examination clumps of edematous and degenerating elastic tissue, and sometimes giant cells. The lesions have been observed chiefly on the neck and a little above the shoulders, on the front of the chest and abdomen, and on the flexor surfaces of the extremities. The disease is differentiated from xanthoma by its occurrence on sites not usually involved by that disease, and microscopically by the absence of fatty degeneration and of xanthoma cells.

Colloid Degeneration of the Skin

This is a rare condition which is due to colloid degeneration of the collagen and elastin in the corium, and is characterized clinically by lemon-yellow translucent nodules a little larger than a pinhead, situated chiefly on the upper part of the face beneath normal or thinned epidermis. The lesions at first give the impression of being vesicles, but when punctured are found to contain only a little gelatinous substance. Histologically, the chief finding is the presence of colloid degeneration, particularly about the glands and the vessels.

BENIGN GROWTHS OF MISCELLANEOUS ORIGIN

Endothelioma

Endotheliomas, arising from the endothelium lining a blood or lymphatic vessel, are among the very rare cutaneous lesions. They are manifest as single or multiple violaceous papules, which are clinically similar to the angiosarcomas. The diagnosis is made by microscopical examination. This reveals a cellular growth from the vascular endothelium taking place at the expense of the vessel of origin, which becomes fairly obliterated by a mass of cells resembling those of large round-celled sarcoma.

SYNOVIAL LESIONS OF THE SKIN

These lesions are rounded opalescent, cystic tumors which develop over the articulations of the digits, chiefly on the dorsal aspect of the distal interphalangeal joints. The surface is covered by a thin, smooth, shiny epidermis. When the cysts are punctured, a straw-colored viscid fluid exudes from the lesion, which later refills. Synovial lesions of the skin are found most often in persons who have suffered from rheumatism. Upon dissection the cyst is found to be attached to the capsule of the underlying articulation by a fibrous cord. Histologically, the lesion consists of a wall of connective tissue covered by an atrophic and compressed corium and epidermis.

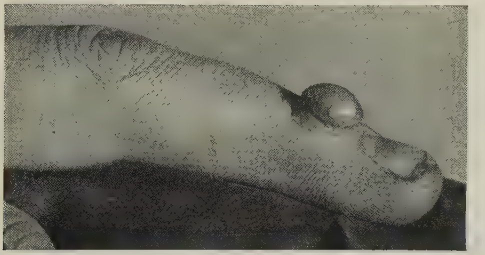

Fig. 847.—Synovial cyst. (Courtesy of Dr. George M. MacKee.)

Treatment.—The lesions have been successfully treated by radiation. Hyde and Ormsby, and MacKee and Andrews used *x*-rays in several cases, and Sutton had equally good results from the application of radium. If surgical dissection is made, the removal must be thorough, or recurrence is likely.

PSEUDONEOPLASMS

XANTHOMA

Xanthoma is a fibrous, fatty growth in the skin, which occurs in three clinical varieties whose common cause is disputed. These are (1) xanthelasma (xanthoma planum palpebrarum, vitiligoidea xanthoma), (2) xanthoma tuberosum multiplex, and (3) xanthoma diabeticorum.

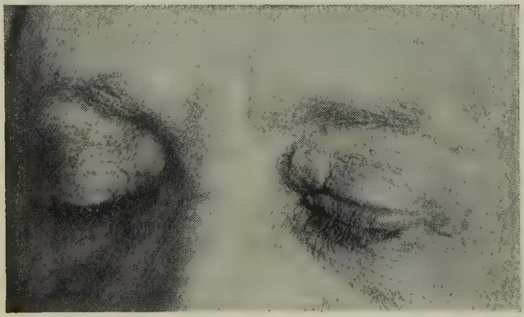

Fig. 848.—Xanthelasma.

Xanthelasma is a common affection of the eyelids characterized by soft chamois-leather-colored or yellowish spots or plaques, which begin near the inner canthus, are frequently symmetrical, and are multiple or coalescent. Pollitzer has shown that there is a fatty degeneration of the orbicularis palpebrarum and a secondary deposit of cholesterin crystals beneath the skin. These lesions may be associated at times with similar ones upon other parts of the face, or with the other varieties of xanthoma. The disorder is encountered chiefly in persons past middle age, and seems more prevalent in women. It begins with one or more pinhead-sized, yellowish spots covered by normal epidermis and slowly in the course of many months these enlarge peripherally and become thicker, so that they form irregularly shaped, pea-sized or nummular plaques or pouches that not infrequently extend over almost the entire skin of the lids. At times they may itch slightly but otherwise cause no symptoms; their appearance, however, is naturally objectionable.

The *treatment* of xanthelasma is by the destruction and removal of the lesions. The destruction is most accurate and thorough when accomplished by desiccation with a high frequency current and a needle electrode. Under novocaine anesthesia the small spark is applied in a crisscross manner until the entire patch has been desiccated. It is not necessary to go beyond the limits of the lesion, but it is important to destroy its whole depth. The detritus is removed by a sharp curet and then the eyelid is covered by borated vaselin, which application is continued until the scab has fallen. Slight depigmentation of the area, which may follow any form of treatment, may be as objectionable in brunettes as xanthelasma itself, but the appearance nearly always is improved by the removal.

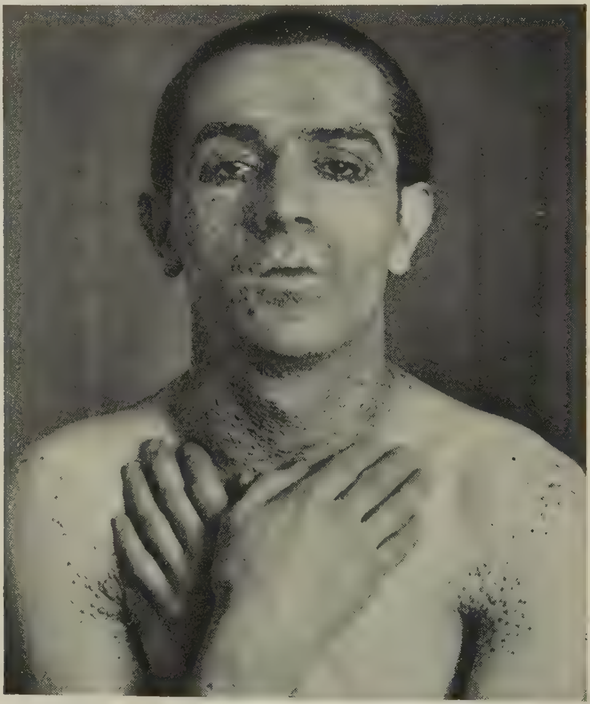

Fig. 849.—Xanthoma tuberosum multiplex. Generalized. A common distribution is shown in the photograph. (Courtesy of New York Skin and Cancer Hospital.)

Patches may also be removed by surgical excision and curettage, adrenalin and novocaine solution being used for anesthesia. For those who do not possess electrical apparatus, this method is recommended. With the patient in a recumbent position, the skin is cut upward in short lengths around the periphery with a pointed scalpel until the patch is circumscribed. The edge of the cut piece of skin is then lifted and separated from its attachment by small, sharp-pointed curved scissors. After it has been removed, the area is inspected for residuary yellowish particles, and if any are found they are removed by a sharp curet. Hemostasis is accomplished by the liberal use of a solution of adrenalin chloride, 1 : 1000. The denuded areas are dressed with borated vaseline. Epiphora and ectropion must be avoided.

Another method of treating xanthelasma is by the application of trichloracetic acid upon the end of a toothpick. Any excess of acid must be removed by holding it against the neck of the bottle. A strong solution of sodium bicarbonate should be at hand for use in emergency. Application is made until the patch is snow white, and when this has healed, if there are remnants, the treatment is repeated.

Xanthoma tuberosum multiplex is variously manifested as flat or rounded multiple nodules, which, while usually located on the elbows and knees, may be found on any part of the skin—on the mucosae, in connection with the tendon sheaths, periosteum, viscera, or practically any part of the body. Whereas the commonest variety consists of pea-sized nodules, more rarely there arise large tumors, linear lesions, or confluent plaques which cover large areas. The color ranges between light yellow and brown. The largest lesions occur over the joints and rarely have been tumors a few centimeters in diameter and pedunculated. In children the lesions are likely to be smaller and more generalized, the eruption resembling urticaria pigmentosa. Linear lesions are observed most often on the palms, appearing as narrow ribbons in the skin over the tendon sheaths, or as lines along the creases. Like other varieties of xanthoma, the affection causes no symptoms but is objectionable because of its appearance and the inconvenience caused by extensive involvement over the articulations. It is found principally in adults who have disorders of the liver or biliary passages, although extensive cases are encountered in children who have no general disturbances.

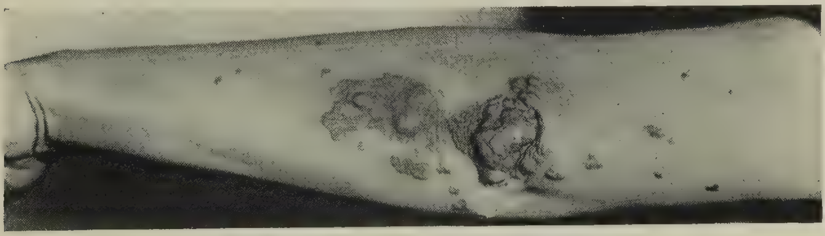
Fig. 850.—Xanthoma tuberosum multiplex.

The diagnosis is usually not difficult because of the peculiar yellow color of the lesions, and their characteristic locations. Confusion may occur in the differentiation of generalized xanthoma from urticaria pigmentosa in children, but in the latter disease there are a distinctive swelling, reddening and an increased prominence of the lesions when they are rubbed, and sometimes dermographism. Microscopically, the differentiation is easy, there being as a rule mast cells in urticaria pigmentosa, and fatty degeneration with xanthoma cells in xanthoma.

Treatment is by removal of the lesions by desiccation with the high frequency current or by refrigeration. Due to the widespread commercial use of dry ice, this method of therapy is now available to everyone. Lesions have been cured by radium and also by roentgen rays, but the dosage required is so great that radiation sequelae almost invariably follow such therapy, and for this reason preference is given to other methods of removal.

Xanthoma diabeticorum is a rare affection of the skin which is found occasionally in association with glycosuria and in diabetes mellitus; also in diabetes insipidus. While it is encountered in young subjects, it is seen more commonly later. The lesions are multiple small, cream-colored, or yellowish nodules, discrete or coalescent, and have a predilection for the extensor surfaces of the elbows and knees, but may occur elsewhere. Early lesions are firm, conical papules, which are generally numerous. These grow and coalesce, so that patches of various shapes and sizes are formed. About the lesions a narrow reddish line due to an inflammatory reaction in the contiguous tissues may be discerned. The eruption appears suddenly, and spreads rapidly and profusely. Favorite sites are the buttocks, elbows, knees, forearms, hands and face, but lesions are found on other parts of the skin and even on the buccal mucous membrane. Xanthoma diabeticorum is differentiated from xanthoma tuberosum multiplex by its rapid course and the inflammatory reaction about its lesions; by their firm consistency and the association with diabetes.

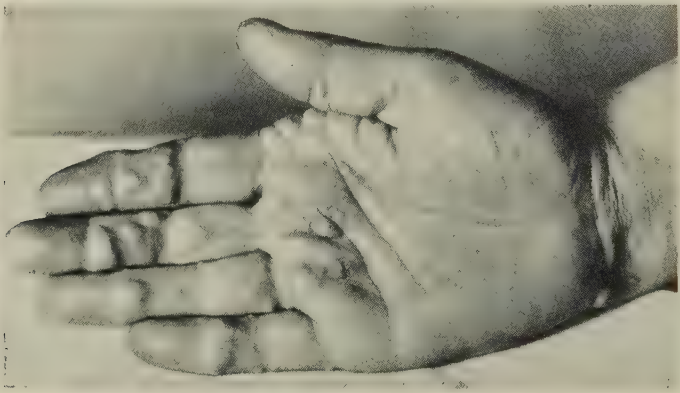

Fig. 851.—Xanthoma tuberosum. Nodules have a somewhat linear arrangement on the flexor aspects of the fingers.

Treatment.—Internal treatment is effective in xanthoma diabeticorum. Appropriate diet and the use of insulin or thyroid extract usually cause the eruption to disappear. As a local treatment fractional doses of roentgen rays are sometimes effective, for the lesions of xanthoma diabeticorum are generally more inflammatory and more radiosensitive than those of xanthoma tuberosum multiplex. A radiation erythema should be avoided.

ESTHIOMENE

Esthiomene is an old term applied to hypertrophy of the labia minora, causing them to hang in the form of pendulous and pedunculated tumors, due to persistent lymphedema and congestion from chronic gonorrheal and syphilitic processes in the lower portion of the female genital tract. His-

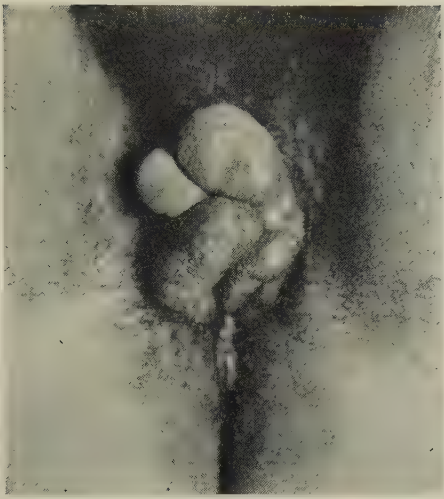

Fig. 852.—Esthiomene. Syphiloma of vulva in a colored woman.

tologically, there are a connective tissue hyperplasia with areas of myxomatous degeneration and a dilatation of the lymphatic spaces.

Foreign-body Tumors

Under the term "pseudoneoplasms" are grouped certain tissue reactions to injections of foreign substances, such as paraffin, camphorated oil, soluble and insoluble salts, *et cetera*. These reactions are inflammatory and eventually lead to indurated and boardlike fibrotic tumors. The development is often accompanied by mild erysipeloid attacks and marked tenderness.

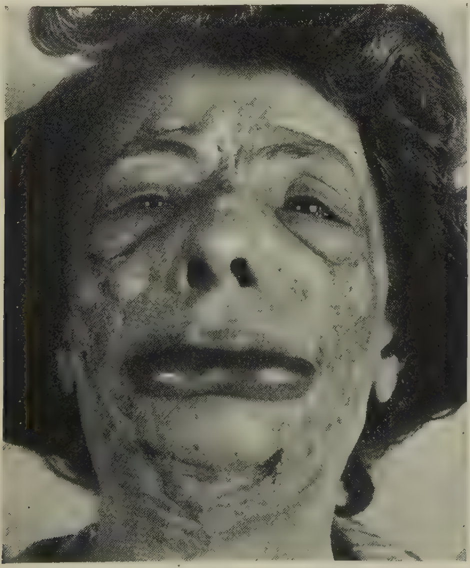

Fig. 853.—Paraffinoma. (Courtesy of Dr. Mihran B. Parounagian.)

Upon this foreign-body reaction there may ultimately form a real neoplasm of malignant character.

Paraffinomas and similar connective tissue tumors due to injections may be benefited in the early stages by repeated small doses of penetrating roentgen rays. The radiation causes resorption of the young proliferating cells and granulomatous structure, but exerts no action upon the paraffin or other ingredient. The therapy should cause no roentgen sequelae and should improve the appearance greatly. When these tumors are treated surgically, it is necessary to remove them widely and completely, for, although the injected substance is at first a discrete mass, it is soon split into small parts by the growth of connective tissue trabeculae into it.

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CHAPTER XXX

MALIGNANT NEOPLASMS OF THE SKIN

Since all neoplasms may prove fatal, it is impossible to draw any rigid distinctions, based upon purely clinical conceptions, between benign growths and those which are malignant. Ewing has stated that the tendency is to restrict the term "malignancy" to tumors that exhibit certain anatomical and clinical features which are essentially deleterious to the host. "The most important of these features are infiltrative growth, local destructive properties, recurrence after removal, formation of metastases, local interference with function and general toxic action of absorbed tumor products." Infiltrative growth is the most important of the anatomical factors.

"Cancer is not a single disease, but many diseases, differing not only in location, but in rapidity of growth and of dissemination. There are a certain number of cases so malignant and so rapid in their development that our present methods are insufficient to cope with them. A majority of cases of accessible cancer, however, are curable by methods of treatment now available in most of our modern hospitals, if only these methods can be applied in the early and favorable stages of the disease."[1] For purposes of treatment it is necessary to comprehend the distinctive features of the various structural types of the malignant neoplasms.

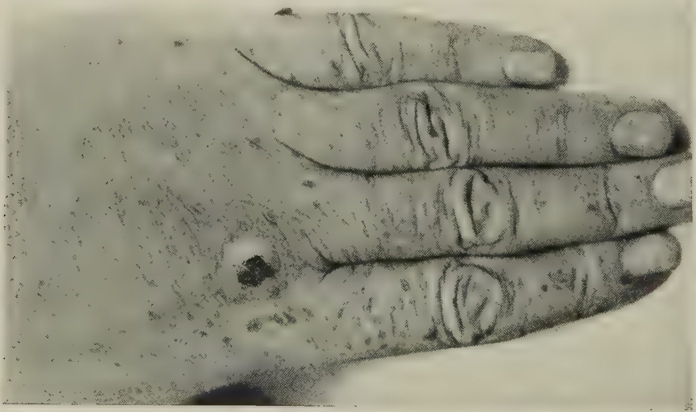

Fig. 854.—Epithelioma, squamous-cell, early lesion. During this warty stage while the tumor is localized proper treatment usually offers a favorable prognosis.

Varieties.—Malignant neoplasms of the skin are usually of epithelial or connective tissue origin, the former being called carcinoma and the latter sarcoma. Nearly all malignant cutaneous tumors are carcinomas, sarcomas being rare. Carcinoma is usually of the basal-cell type; next in frequency and of primary importance on account of its greater mortality is squamous-cell carcinoma. More and more it is becoming recognized that cancer is not a disease entity, but is a malignant process characterizing an extensive group of diseases which differ within wide limits clinically and histologically.

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[1] Greenough, R. B.: End Results of Cancer Cases and the Factors Determining Them, Am. J. M. Sc., 173: 412–420, March, 1927.

COMMON TYPES OF SKIN CARCINOMA

Squamous-cell Carcinoma (*Pavement Epithelioma, Prickle-cell Carcinoma, Squamous-cell Epithelioma, Epidermoid Carcinoma*).—This is a neoplasm arising from the epidermis and is characterized by the presence of adult squamous cells, cornification or "pearl" formation. Clinically, most of these tumors go through an early papillomatous stage in which they appear as warty, superficial outgrowths, although a few begin as depressed, more or less flat indurations and infiltrations. The local growth possesses a solid infiltrated margin, while the ulcerated center is crusted or raw and granular, with a tendency to bleed.

Frequently squamous-cell epithelioma begins beneath a keratosis, clinically being a superficial discrete, hard, infiltrated ring about central corneous material. In other instances, the tumors begin as small erythematous, infiltrated, hard, scaly plaques. In the course of weeks or months the lesions become larger, deeply nodular, and ulcerated. The ulcer is at first superficial and is hidden by a crust. When this is removed, a well-defined, usually papillary, base is discerned and on palpation one feels a discrete hard mass. In the early phases this induration is localized, elevated, and freely movable on the underlying structures; later it gradually becomes diffuse, more or less depressed, and fixed. The growth extends and as a rule invades chiefly the underlying tissues, but sometimes remains largely superficial and extends over a wide area or becomes a bulky raised tumor. The edges are invariably hard and usually everted. The ulcerated surface may be papillomatous or cauliflower-like, composed of densely packed, filamentous projections, between which are clefts filled with a viscid, purulent, malodorous exudate.

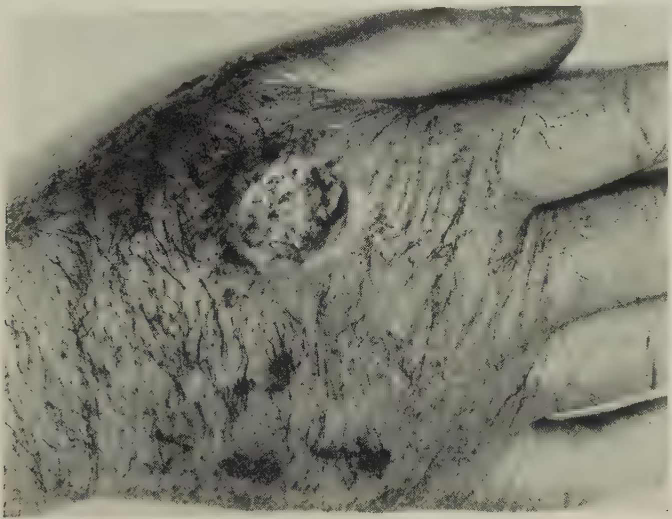

Fig. 855.—Epithelioma, squamous-cell, of back of hand. Note senile keratoses. This is a more advanced stage in which the tumor is ulcerated and fixed to underlying structures leading to a less favorable prognosis.

The development is characterized by comparatively rapid and destructive growth locally, extension into the connective tissue, cartilage, periosteum and bone, and by metastatic extension into the regional lymph nodes; and sometimes by metastatic tumors in the internal organs.

In the primary, cornifying, papillary stage, the lesion being circumscribed and not fixed to the deeper structures offers a good prognosis, but as ulceration or infiltration supervenes the prognosis becomes grave.

Middle aged or elderly persons especially are affected. The principal regions involved are the mucous membranes and mucocutaneous junctions, the face, the backs of the hands, the lower lip, the nipples, genitals, and the extremities; and sometimes the scalp, ears, neck, axillae, and the digits.

Although the entity of primary carcinoma of the skin arising from various anatomical structures, from diverse causes, has not been differentiated, studies of lip and mammary cancer have indicated a basis for discovery of variations in the life history, course, extension, prognosis, and best treatment peculiar to various members of the group now comprehended by the term "carcinoma cutis."

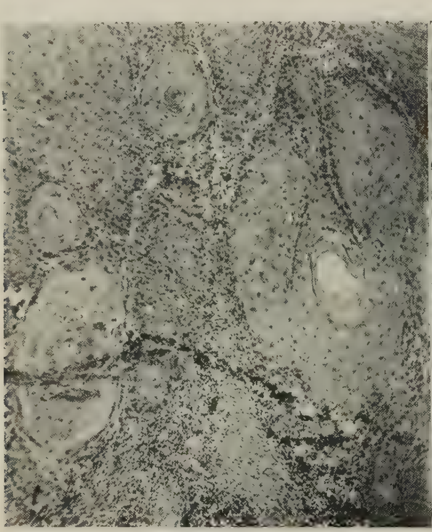

Fig. 856.

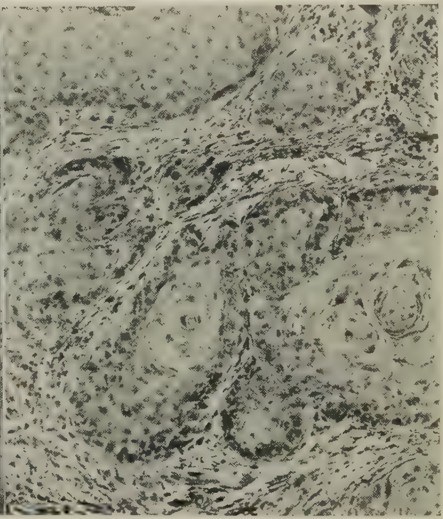

Fig. 857.

Fig. 856.—Squamous-cell epithelioma of the tongue, Grade 1.
Fig. 857.—Squamous-cell epithelioma of the tongue, Grade 2.

From microscopical appearances, Broders has graded the relative malignancy of squamous-cell epithelioma of the tongue in a manner which may be applied more or less usefully to squamous-cell epithelioma of the skin. "Grade 1 epithelioma, one in which the differentiation or self-control ranges from almost 100 per cent to 75 per cent, and undifferentiation from almost nothing to 25 per cent; a Grade 2 epithelioma, one in which differentiation or self-control ranges from 75 per cent to 50 per cent, and undifferentiation from 25 per cent to 50 per cent; a Grade 3 epithelioma, one in which differentiation or self-control ranges from 50 per cent to 25 per cent, and undifferentiation from 50 per cent to 75 per cent; and a Grade 4 epithelioma, one in which differentiation or self-control ranges from 25 per cent to practically nothing, and undifferentiation from 75 per cent to practically 100 per cent."

Basal-cell Carcinoma.—These lesions develop from the basal cells of the

Malpighian layer of the skin and are characterized by slow evolution and a persistent tendency to local recurrence after operative removal. Certain clinical types of basal-cell epithelioma have descriptive value:

1. Flat cicatricial, which presents a cicatricial surface with small pearly papules and telangiectatic vessels at the periphery, sometimes superficially ulcerated. Examples of this type are occasionally called morphea-like epitheliomas.
2. Superficial pagetoid consisting of an erythematous plaque, sometimes with scales or crusts resembling Paget's disease of the nipple, and usually with a threadlike elevated margin. Slight atrophy or scarring may be present.
3. Button-like, in which there is a projecting reddish translucent tumor about the size of a nut.
4. Cystic variety, which is characterized by multiple soft translucent cysts containing gelatinous fluid.

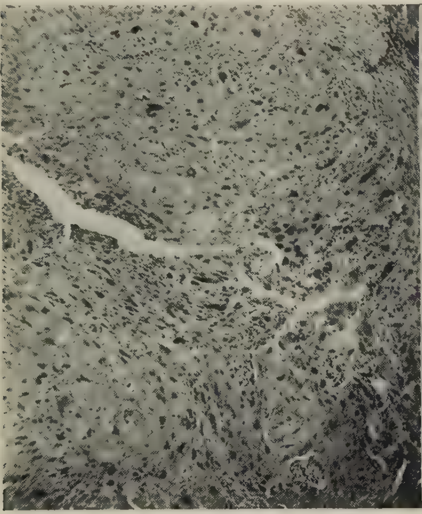

Fig. 858.

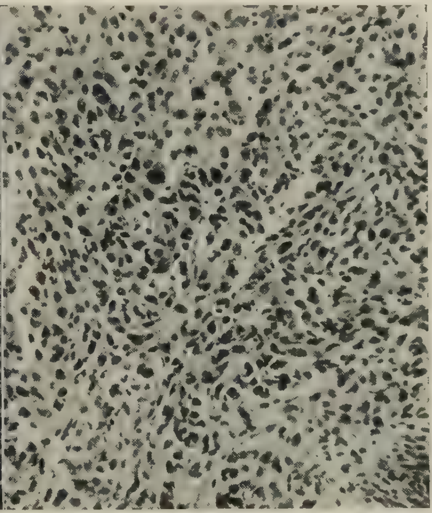

Fig. 859.

Fig. 858.—Squamous-cell epithelioma of the tongue, Grade 3.

Fig. 859.—Squamous-cell epithelioma of the gum, Grade 4. (Courtesy of Dr. A. Compton Broders.)

5. Rodent ulcer, which is a terebrant serpiginous ulcer, slowly progressing during a period of twenty to thirty years, and leading to horrible mutilation, severe hemorrhage or meningitis.

The tumors may begin in senile keratoses on the face, ears, dorsa of the hands, and occasionally on other areas, or in other varieties of skin lesions. The first evidence of the growth in a senile keratosis is the development of an erythematous zone about it and a nodular thickening in it. Removal of the crust reveals a superficial bleeding granulating ulcer. Sometimes even in such early lesions, characteristic pearly nodules can be discerned.

These nodules are of diagnostic importance and fairly distinctive of basal-cell epithelioma, although they are seen occasionally in other types. They are pinhead to split pea sized, waxy, semitransulcent, firm, smooth, and of a pearl, pale lemon, or straw color. Adjacent nodules are frequently confluent and form irregularly rounded pea-sized or larger tumors over which telangiectatic vessels course. At the edges of ulcerated basal-cell growths these characteristic pearly nodules are present, if not about the entire edge, at least in some portions of it. There they form a pearly, unevenly nodular border, which is hard, shiny, semitranslucent, and frequently everted, being sometimes hidden by a superimposed crust.

Basal-cell epitheliomas run a chronic course, during which new nodules develop, crusts form and fall off, and the ulceration enlarges. As a rule there is a tendency at times for the lesions to bleed a little, but they cause no pain or other symptoms. Some of the lesions tend to heal spontaneously and form scar tissue as they extend. Peripheral spreading may produce configurate, somewhat serpiginous patches, which simulate the ulcerative syphilide. The ulceration may burrow deep into the subcutaneous tissues, or even into cartilage and bone, causing extensive destruction and mutilation. The floor of the ulcer is covered by viscid necrotic material, crusts, and some serosanguineous discharge. This type is termed "rodent ulcer," and in spite of the well marked tendency to invade locally, it does not generally metastasize.

The *differentiation* of squamous-cell from basal-cell epithelioma is not always possible without a microscopical examination. It is important, however, to recognize more or less reliable points of contrast in these two chief types of skin cancers.

The duration of the lesion if over three or four years points strongly to it being a basal-cell growth. If the lesion has been present under one year and is the size of a bean, the diagnosis of squamous-cell epithelioma must be entertained, especially if there is a fair amount of local hyperemia, or dilated blood vessels are noticeable about its periphery or on its surface. Basal-cell lesions do not ordinarily grow to such a size in such a short period and are not usually congested.

Cornification is distinctly a property of the squamous-cell type. Horny material, which must not be confused with crusts, is not formed as a rule in basal-cell lesions.

A pearly nodular rolled edge is fairly characteristic of basal-cell growths, but is sometimes encountered in the squamous-cell type, particularly in arsenical epitheliomas. Such a semitranslucent waxy edge must be discriminated from the solid border found in early squamous-cell epitheliomas. The latter is usually an elevated, hard, infiltrated, ringlike margin which surrounds or is surmounted by cornified substance.

An inflammatory reaction is generally present about squamous-cell growths and absent about basal-cell growths.

Generalizations about location are both helpful and misleading. Both types of lesions may occur anywhere on the skin. However, the basal-cell lesions are found chiefly on the face, especially on the nose, forehead, eyelids, temples, and upper lip, whereas the squamous-cell growths are found principally on the mucous membranes, at the mucocutaneous junctions, and on the extremities. There is, however, a tendency to underestimate the frequency of squamous-cell epitheliomas on the nose and adjacent parts. Epithelioma of the rim of the ear may be either basal-cell or squamous-cell. In the aural canal, and above, behind, below, and in front of the ear basal-cell growths are common. Epithelioma primary on the vermilion of the lower lip is as a rule composed of squamous-cells, and epithelioma of the penis and of the vulva is generally of the latter type. On the extremities epithelioma is usually also of the squamous-cell type. These lesions are encountered most often on the dorsa of the hands, generally developing beneath a keratosis, and forming a solidly infiltrated raised ring with a horny outgrowth in the center.

The age of the patient is not a good criterion for differentiation, although squamous-cell carcinoma of the skin is more frequent in subjects between the ages of thirty and fifty years than basal-cell tumors, which usually occur later.

Transitional-cell Carcinoma.—Between the squamous-cell and the basal-cell epitheliomas there are histologically mixed forms in which the characteristic picture of each type is present in one growth, and intermediary forms in which the cells are not typically basal or squamous. These are called "metatypical" growths by Darier. Jadassohn states that these nonclassical forms incline more to the basal-cell type, but are thought to be more malignant and less amenable to radiotherapy. Transitional-cell epitheliomas are apparently more common than is usually considered. Montgomery has stated that they occurred in about 12 per cent of a series of 119 cases of epithelioma of the skin. They are, as a rule, indistinguishable clinically from basal-cell epitheliomas, a positive diagnosis being made only by microscopical examination. Probably most of the so-called "metastatic basal-cell epitheliomas" are, in reality, transitional cell.

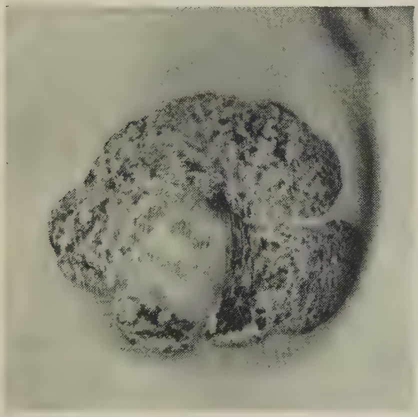

Fig. 860.—Paget's disease of the nipple.

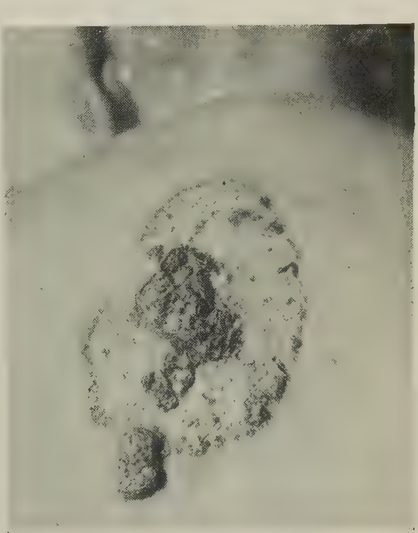

Fig. 861.—Bowen's disease. (Courtesy of Dr. Fred Wise.)

RARE TYPES OF SKIN CARCINOMA

Paget's Disease (Malignant Dermatitis, Eczematoid Epitheliomatosis).—This is a specific and rare form of epithelial disease which is essentially carcinomatous and usually involves the female nipple or areola. It is characterized by an early eczematoid stage and the presence microscopically of peculiar hydropic cells. The disease begins as an erythematous, crusted or keratotic, circumscribed, pruritic patch, which in the course of years becomes infiltrated, and ulcerated and almost invariably develops into a carcinoma. It is differentiated from eczema by the age of the patient, the recalcitrance of the lesion to treatment, the induration, and the histology. Several extramammary cases have been reported, with locations on the genitals, buttocks, umbilicus, axilla, and elsewhere on the trunk.

The conception has been that Paget's disease begins as a dermatitis which gradually becomes malignant and travels into the mammary gland. Pautrier recently expressed the opposite view, namely, that the disease is a skin manifestation secondary to deep-seated carcinoma which affects the nipple by progressing along the lymphatics and the milk ducts which converge there. Ewing suggests that Paget's disease occurs in both of these different forms, stating that its duration, wide and superficial extension, occasional extramammary occurrence and the long absence of any definite tumor make it unlikely that the condition can be dismissed as a peculiar form of skin invasion by mammary duct carcinoma.

Bowen's Disease.—This resembles Paget's disease, from which, however, it is clinically and histologically distinct. It appears as isolated, grouped or disseminated, brownish-red scaling macules or papules, or as a serpiginous patch with central atrophy, or as real tumors with ulceration. Bosellini calls attention to the relationship between Bowen's disease and senile keratoses. Histologically the epidermis is thickened and irregular, and there is a dyskeratosis with irregularity in the size and shape of the cells, mitotic figures, hyperchromatism and clumping of nuclei. There are also epithelial giant cells, and more especially large cells with darkly staining, clumped, nuclei surrounded by vacuoles. The surface of the growth is often hyper- and parakeratotic, and beneath it there is a dense cellular infiltration of lymphocytes and plasma cells. The basal-cell layer may be somewhat distorted, but there is a notable absence of downward "budding" of masses of cells into the corium.

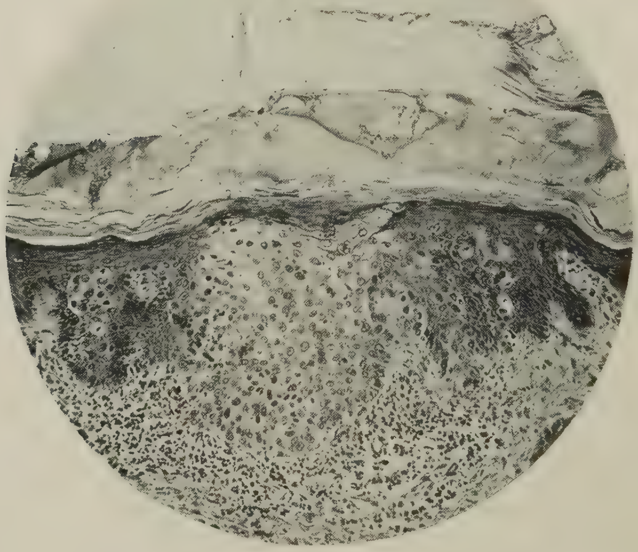

Fig. 862.—Bowen's so-called "precancerous dermatosis," with characteristic changes in the epidermis; early stage. (Courtesy of Dr. Fred Wise.)

Intra-epidermal Epitheliomas.—Other varieties of intra-epidermal epitheliomas are encountered and have been described under various names

(Borst and Jadassohn). They are usually multiple, superficial, flat growths which exhibit little progressive tendency, being frequently classified as "nevoid." Generally the lesions arise in otherwise normal skin and are composed of basal cells, although occasionally of prickle cells or a mixture of the two. Such lesions have frequently been confused with Bowen's disease and extramammary Paget's disease.

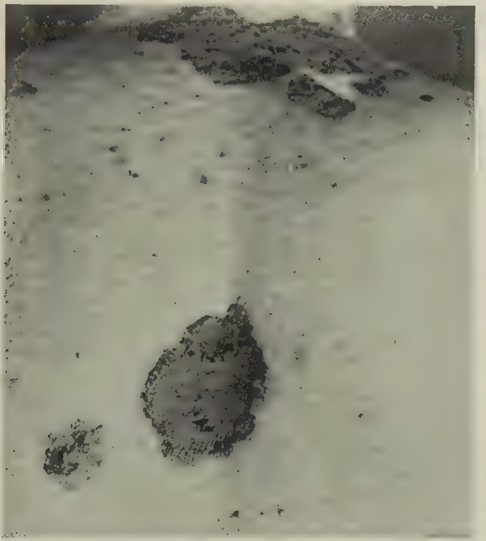

Fig. 863.—Multiple superficial flat epitheliomas. (Courtesy of Dr. Fred Wise.)

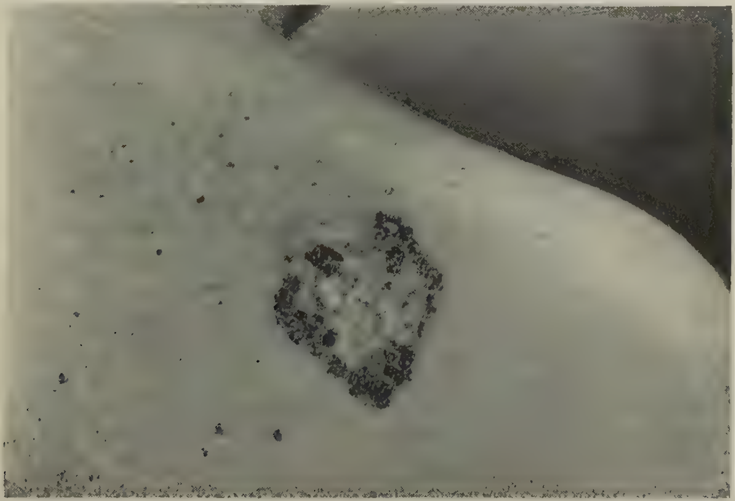

Fig. 864.—Multicentric basal-cell epithelioma of the shoulder. (Courtesy of Dr. Paul Gross.)

Multicentric Epithelioma.—Multicentric basal-cell epitheliomas are an uncommon type of superficial growth, which are often intra-epidermal. Clinically they appear as small pearly nodules, sometimes on an erythematous base or covered by crusts. They are slowly growing lesions with little tendency to invade or destroy. The diagnosis is made histologically by multiple points of origin, for in the epidermis, often very sharply differentiated, are accumulations of small cells with dark nuclei which apparently mark the beginnings of basal-cell tumors.

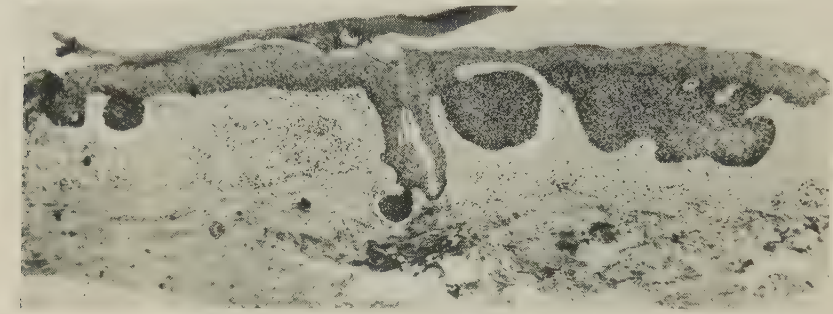

Fig. 865.—Multicentric basal-cell epithelioma. (Courtesy of Dr. Paul Gross.)

Pigmented Basal-cell Epithelioma.—This variety is generally a flat superficial tumor, characterized by slow growth and a pearly nodular appearance. At times crusts are formed on the surface, and when these are removed, the underlying granular base bleeds readily. The pigment is light or dark brown, but never, in my experience, blue or black. This feature, as well as slowness in growth, long duration, flat superficial extent, and the presence of pearly nodules, serves to differentiate the pigmented basal-cell epithelioma from melanoma. The treatment is the same as for other varieties of basal-cell epithelioma. The pigment is melanin and microscopically is both in the tumor cells and in Langerhans' cells in the corium; it is also extracellular.

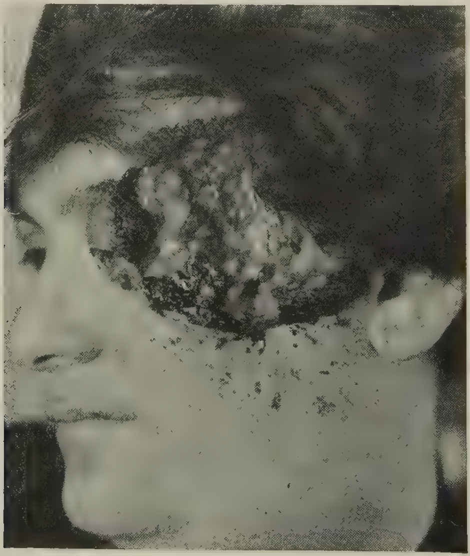

Fig. 866.—Basal-cell epithelioma, adenoid type.

Adenoid Epitheliomas of the Skin.—In addition to the growths which arise from the superficial epithelium, other varieties originate in the skin appendages, and sometimes microscopically are of an adenoid structure, exhibiting a tendency to reproduce the dermal glands, with, however, a predominance of squamous- or basal-cell characteristics.

Certain tumors of this category which are usually classified as multiple benign cystic epitheliomas have already been described under that caption. Also single bulky tumors of the skin on the face and neck rarely show adenoid and cystic structure and slow growth characteristic of these small multiple epitheliomas. Adenoid cystic epithelioma of the scalp appears as round, lobulated, reddish tumors of long duration—so-called "tomato tumors"—and is usually benign. Sometimes adenoid cystic epithelioma becomes widely disseminated and the metastases show a predilection for the bones.

Occasionally more actively growing tumors occur which have an alveolar structure, cysts being absent. The cells lining the alveoli are more or less cuboidal. Such lesions clinically resemble basal-cell growths and may attain bulky dimensions, being generally sharply circumscribed. They are observed chiefly on the face in the common locations of rodent ulcer. Their course is progressive, at times with ulceration or with extension to the adjacent lymph nodes.

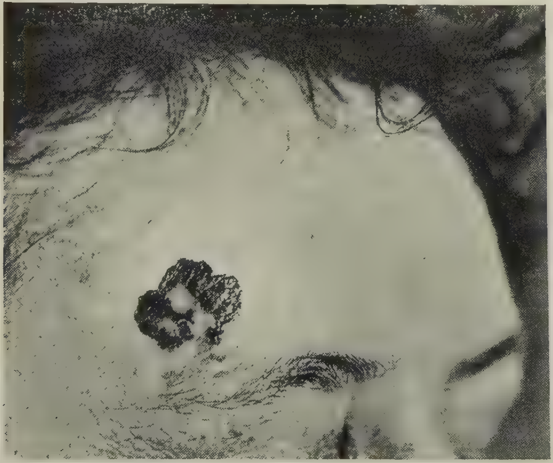

Fig. 867.—Melanoma. Arose from a light brown soft mole on forehead. Note small satellite midway between eyebrow and main lesion and dark streak extending downward like a shadow. This streak was bluish black.

Metastatic Carcinoma.—Cutaneous metastases develop most frequently from cancer of the female breast or of the prostate gland. The skin lesions are generally multiple nodules or flat infiltrations, which may coalesce to extensive dimensions and thus obscure the primary tumor. Diffuse infiltration of the skin over the region of a carcinomatous breast may occur either before or after its operative removal. When the skin becomes leathery, indurated, and hide bound, the condition is termed "lenticular carcinoma," which is a clinical variety of the scirrhous type. The surface is dotted here and there, sometimes densely, with reddish or yellowish firm, smooth, rounded nodules, and at other times with ulcers, crusts, or fungoid tumors. As a result of coalescence and infiltration the thorax becomes compressed by an indurated leathery jacket, this condition being called "cancer en cuirasse." Tuberous carcinoma is another example of the scirrhous type, in which innumerable metastatic nodules develop and ulcerate. Enlargement of the axillary glands due to metastases, and edema due to obstruction of the lymphatics produce a swelling of the extremity and tormenting pain.

MELANOMA (Nevocarcinoma, Melanotic or Pigmented Sarcoma)

These tumors, belonging to the group of embryonic cancers, arise from pigmented or nonpigmented moles,[1] and are known for their extreme viciousness and resistance to irradiation. Confusion exists in regard to the proper nomenclature for these growths, because the origin and nature of their cellular and pigment constituents are disputed.

The moles which are a source of melanomas occur on any portion of the integument. Masson has noted a relation between them and neural end organs. They are more liable to malignant changes when in positions subject to chronic irritation, especially on the great toe, heel, sole of the foot, or inguinal region. *Melanotic whitlow* is a type which develops from collections of nevus cells in the nail-bed or lateral nail-fold. It forms an ulcerated tumor which early metastasizes to the regional lymph nodes.

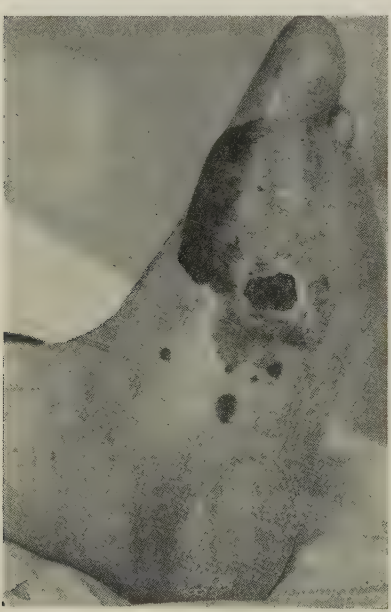

Fig. 868.—Melanoma of the foot. (Courtesy of Dr. Nathan T. Beers.)

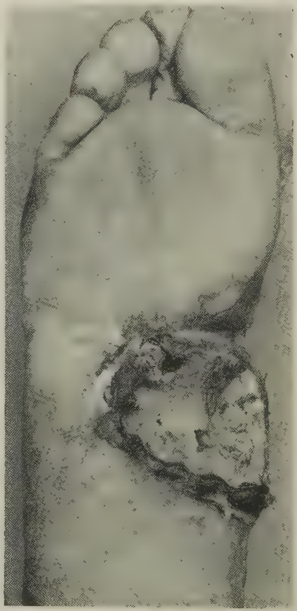

Fig. 869.—Melanoma of the inner border of the foot. The edge of the tumor is heavily pigmented. (Courtesy of Drs. Arthur E. Hertzler and Edward T. Gibson.)

The tumors begin as firm hyperpigmented nodules usually after a period of crusting, bleeding, or increase in size, in firmness or depth of color of the antecedent nevus. The early nodules may appear within the substance of the nevus, in which case they are, as a rule, near the periphery, or just beyond its margin; or the first evidence of the disease may be a metastatic enlargement of the adjacent glands or the appearance of cutaneous metastases on distant parts. Although the tumors are at first pinhead to pea size, they may grow much larger and become papillary, fungoid, or ulcerated. The color is usually not uniform throughout the tumor, but is likely to be irregularly scattered, being grayish brown, bluish black, or black.

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[1] Reference should be made to the chapter on Nevi.

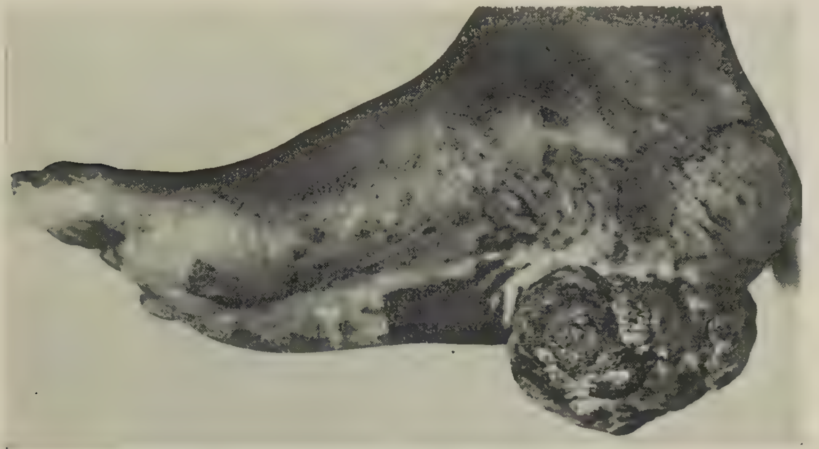

Fig. 870.—Large fungating melanoma of the heel without visible involvement of the surrounding skin. (Courtesy of Drs. Arthur E. Hertzler and Edward T. Gibson.)

In nearly all instances, pigmented nevi in the course of decades become fibrotic and small, and show other regressive changes. Only rarely, and usually after trauma or incomplete removal, do malignant changes develop. The skin is the chief site of the early metastases, and dissemination may be evidenced also by melanemia, melanuria, and cachexia. The

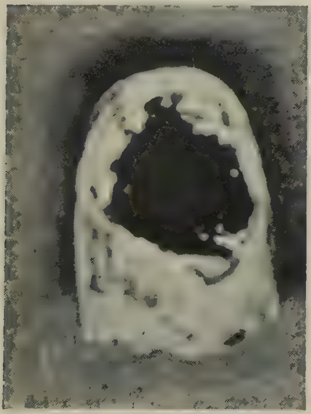

Fig. 871.—Melanotic whitlow. Amputated finger end, showing granular melanotic mass in the nail-bed, the nail having been cast off. (Courtesy of Dr. Arthur E. Hertzler.)

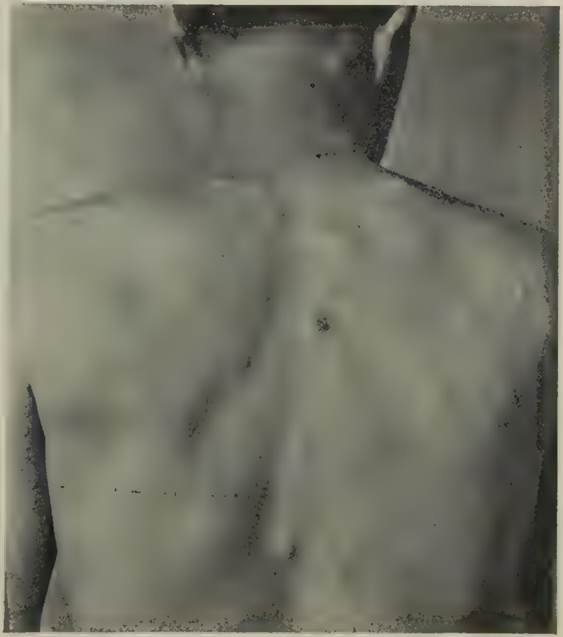

Fig. 872.—Metastatic nodules of disseminated melanoma. (Courtesy of Dr. A. Benson Cannon.)

cutaneous metastases are characteristically hard, more or less pigmented, rounded, smooth growths, which may appear either in the vicinity of the original tumoror at points, distant from it.

SARCOMA

Malignant connective tissue tumors appear infrequently in the skin as either primary or metastatic lesions. A diversity of structural forms is encountered, many of which are unclassified. In general, the three varieties described by De Amicis are of major importance: (1) Nonpigmented sarcoma, local or generalized; (2) melanotic sarcoma; (3) multiple pigmented hemorrhagic sarcoma. Two other varieties of sarcoma, in addition, may be recognized. The first of these, the sarcomas occurring in infants, was described by Dubreuilh in 1911. The tumors arise most often during the first few months of life, or may even be congenital. They are round- or spindle-celled growths, as well as angiosarcomas. The second variety, the alveolar sarcomas, was described by Darier in the same year under the title of "lymphosarcoma" and later as "sarcome atypique à cellules polymorphes." Microscopically these growths have an alveolar structure, being composed of remarkably polymorphous, immature, small, and large round cells, and fusiform and stellate cells. These sarcomas may resemble atypical carcinoma so closely that the identity of the group is still open to criticism.

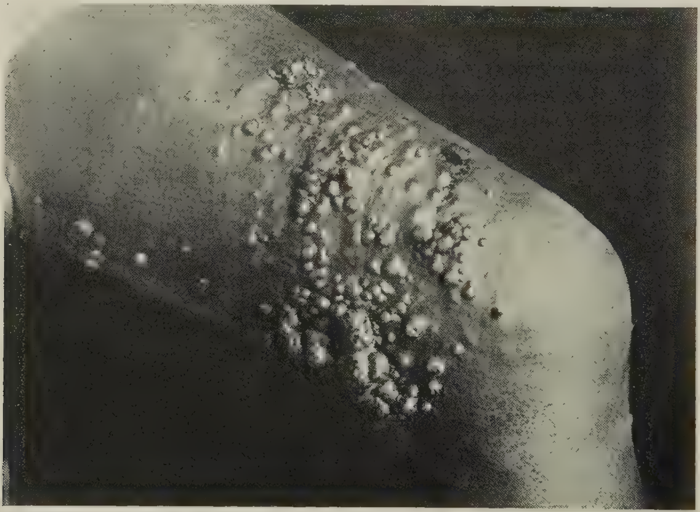

Fig. 873.—Extensive spindle-cell sarcoma of the skin. (Courtesy of Dr. Lloyd F. Craver.)

Localized nonpigmented sarcoma of the skin occurs usually as multiple pea-sized or slightly larger firm, rounded, marble-like hypodermic nodules. Sometimes there is only a single discrete, smooth tumor. The lesions may arise in the skin or beneath it, generally the latter. Probably a large number are neurogenic. When the lesions are subcutaneous, the skin overlying them is of normal appearance and color, but frequently it is somewhat erythematous. Otherwise the nodules are yellowish or purplish. They may be discrete or confluent, and as a rule are localized to the neighborhood of the primary lesion. When coalescent, the nodules form irregularly oval palm-sized or smaller infiltrations, which may be elevated and covered by stretched skin that has the appearance of pigskin. Their essential feature is their slowness of growth and often for many years they show no invasive or malignant qualities. They occur, however, with marked regularity near the primary site after excision, frequently appearing in bead-like formation, which suggests their neurogenic nature. The tumors may disappear under appropriate treatment, but new ones develop in neighboring skin so that the disease continues localized to the region of origin for indefinite periods. Ultimately general internal involvement is likely to supervene and to cause death. In some cases, however, apparent cures have been obtained by radiotherapy, or by extirpation.

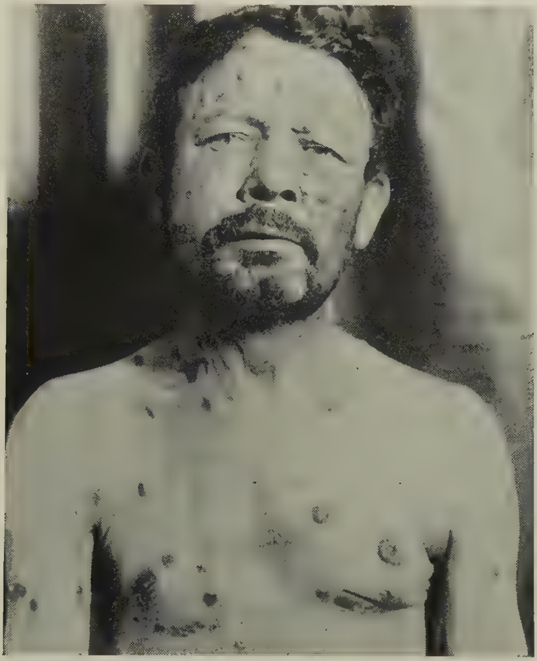

Fig. 874.—Metastases of round-cell sarcoma in the skin. (Courtesy of Dr. Edward A. Oliver.)

Generalized nonpigmented sarcoma in many respects seems related to the lymphoblastomas. Frequently it is impossible to determine whether the skin lesions or the visceral lesions are the primary focus of the disease. The outcome is invariably fatal.

Melanotic sarcoma, also called melanoma, has been described under the latter caption.

Multiple pigmented hemorrhagic sarcoma (idiopathic multiple pigmented sarcoma) was described by Kaposi, in 1872, as being a relatively benign connective tissue tumor, which usually appears in multiple lesions on the extremities, especially the legs. Men are affected more often than women, generally after the fourth decade of life. The early lesions appear on the hands and feet as reddish, purplish, or bluish-black nodules of a rubbery or firm consistency. These lesions are frequently poorly defined, and may be discrete or may coalesce into infiltrated plaques. Telangiectases may occur over the nodules or about them. Rarely some of the lesions are cystic, and vesicles and bullae have been recorded. Later, nodules may appear on the face, ears, trunk, buccal mucosa, and other parts. In some respects the lesions suggest granulomas, angiomas, or neurofibromas. The position of this disease among the sarcomas is subject to argument. The course of the disease is slowly progressive, new nodules developing, and gradually leading to great enlargement of the extremities, lymphedema, and malodorous ulceration. There are, however, periods of remission, particularly in the early stages of the disease, when nearly all of the nodules spontaneously involute and new lesions are scanty. After involution of a nodule there is usually a depressed atrophic hyperpigmented scar. The nodules may be moderately tender, but they cause no severe discomfort until the terminal stages when the parts are swollen and ulcerated. Death generally ensues in four to six years, although many patients live twenty years or more. Complete and spontaneous recovery has been reported. Sarcoma of the viscera is the usual cause of death.

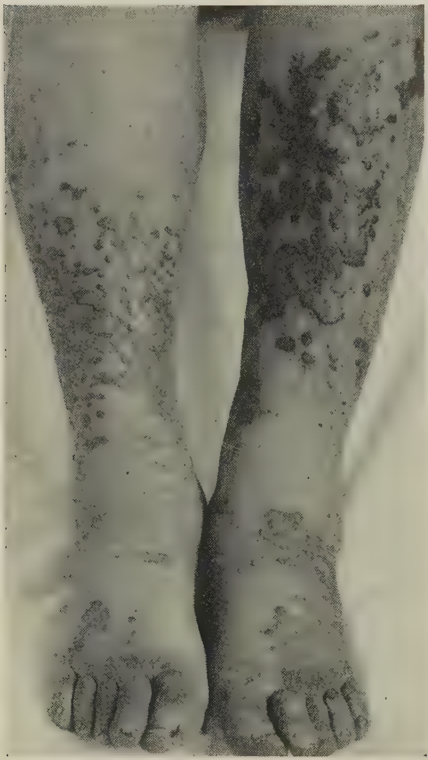

Fig. 875.—Multiple pigmented hemorrhagic sarcoma (Kaposi). Characteristic distribution. (Courtesy of Dr. Benjamin F. Ochs.)

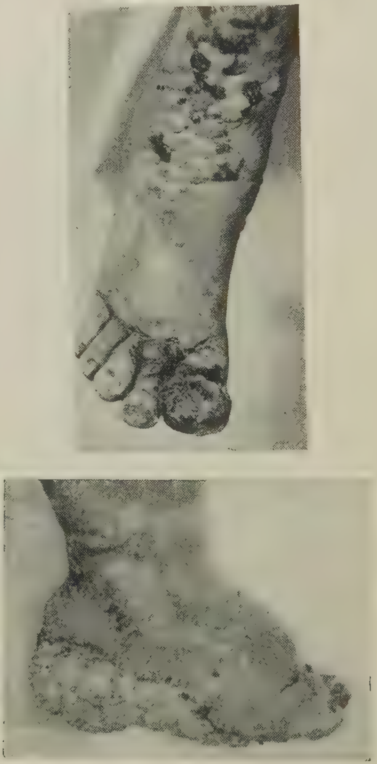

Fig. 876.—Multiple hemorrhagic sarcoma (Kaposi). Extensive involvement of the feet.

ETIOLOGY OF MALIGNANT NEOPLASMS

The reader is referred to the bibliography for information upon this important subject, which is but briefly considered here. The ultimate explanation of cancer is unknown. That chronic irritation plays a rôle in its production in some cases is generally conceded. It may be solely contributory to conditions under which metaplasia may occur. "Yet from the practical standpoint irritation is the important factor, and all other influences, such as heredity, or local predisposition, are secondary." According to Janeway, the essential change applicable to all cases in the transition of somatic cells into cancer cells is primarily of the nature of a degeneration; a degeneration which in one class of cases depends upon the existence of a previously isolated group of cells (Cohnheim's theory); in another class, upon lesions in the connective tissue stroma, including among these changes subepithelial capillary congestion; and in still a third class—which is by no means a numerically unimportant one—upon metaplastic activity for which the epithelial cells alone are responsible. The development of cancer in these latter cases is unassisted by any change in the connective tissue stroma, and individuality of the cells is doubtless a determining factor in the beginning of the degeneration in them. Skin cancer "arises from previously normal epithelium after a period of overnutrition and overgrowth, during which the subepithelial tissues become altered and less resistant. Lymphocytic infiltration, swelling with mucoid or other forms of degeneration, followed by atrophy of elastic tissue, and chronic edema or fibrosis, usually but not always precede the downward growth of epithelium. Yet the controlling influence must, I believe, be regarded as inherent in the epithelial cell. All cutaneous epithelium must be considered capable of developing acanthoma, for which it is only necessary to supply the proper conditions."[1]

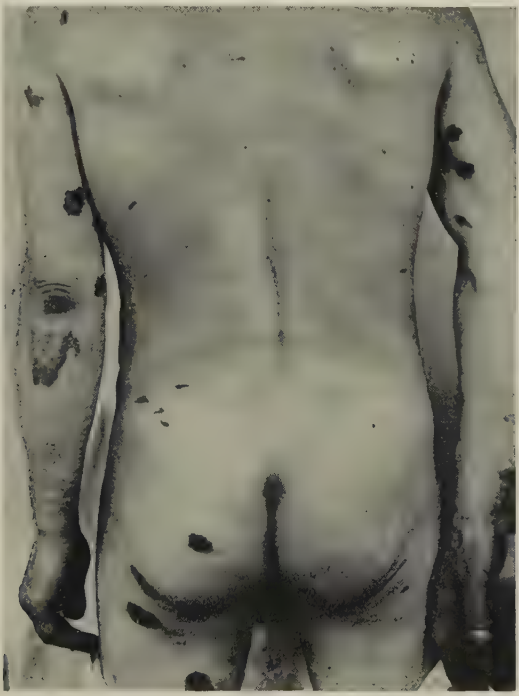

Fig. 877.—Kaposi's multiple hemorrhagic sarcoma, disseminated plaques.

Small frequently repeated exposures to certain physical agents—light,

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[1] Ewing, James: Neoplastic Diseases, W. B. Saunders Co., Phila., 1928, 3d ed., p. 864.

x-rays, radium rays, heat and cold—result in the development of carcinoma of the skin fairly regularly in certain individuals and conditions. The incidence of cancer of the face and hands in farmers, sailors, and gardeners is well known, as is also the development of cancer after small repeated exposures to *x*-rays and radium rays. The Kangri cancer, occurring in Indian natives beneath a hot oven worn on the abdominal wall, and the cancer which occurs after frost-bite are other illustrations. That mechanical trauma, single or often repeated, may have similar results is within the realm of possibility, and not infrequently wounds containing foreign bodies give rise to cancer.

Internal administration of arsenic may lead to epidermal proliferation which produces keratoses of the soles and palms, and carcinoma. Arsenical cancer is usually of the squamous-cell type, although at times the lesions may be relatively inactive, superficial, flat epitheliomas resembling Bowen's disease, or composed of basal cells.

Continued exposure to tar, soot, lubricating oil, paraffin, and other hydrocarbons may cause erythematous itching macules, pigmentations, and keratoses, which ultimately become cancerous. Cancer has been produced experimentally by coal tar and extracts from coal tar. Jorstad and Lane believe these substances, as well as *x*-rays, act as lipoid solvents in inducing a malignant condition. Chimney-sweeps' cancer and mule-spinners' cancer are varieties caused respectively by soot and lubricating oil. The frequency of cancer of the bladder among aniline workers is explained by the chemical irritation of aniline and similar derivatives, which presumably exert at least a harmful action upon the skin. Chronic irritation from projecting or carious teeth, smoking or syphilitic lesions of the mouth are predisposing causes of cancer of the tongue and lips. Cancer of the lower lip is encountered almost entirely in male adults who are smokers, being particularly prevalent among inveterate pipe smokers.

Certain chronic inflammatory diseases of the skin are frequently sites of the development of carcinoma, well known instances being lupus vulgaris and lupus erythematosus, particularly the former. The treatment of these diseases by *x*-rays, radium, and caustics increases the likelihood of carcinomatous changes. Although at first the progress of the carcinoma may be restricted by scar tissue, it grows rapidly and usually terminates fatally after it has passed beyond such limitations. Syphilis, blastomycosis, and other chronic inflammatory diseases may be followed by epithelioma. Leukoplakia, chronic fissures, sinuses, and fistulas are often the sites of development of carcinoma.

Warts, moles, cysts, and other excrescences may undergo malignant degenerative changes with the formation of carcinoma. Such growths are usually of the squamous-cell type, or in the case of moles, the tumors are generally malignant melanomas.

The tendency of carcinoma to develop upon certain preexisting diseases of the skin has led to the recognition of the following conditions as precancerous dermatoses:

Burns.
Chronic actinic dermatitis (sailors' and farmers' skin).
Roentgen and radium dermatitis.
Xeroderma pigmentosum.
Keratoses (seborrheic, arsenic, Darier's diseases, etc.).
Verrucae (vulgaris, acuminata).
Leukoplakia.

Papillomata.
Cornu cutaneum.
Nevi (especially pigmented moles).
Cysts.
Chronic ulcers (crural, decubitus).
Chronic fissures.
Sinuses and fistulas.
Paget's disease and Bowen's disease.
Lupus vulgaris and lupus erythematosus.
Syphilis.
Blastomycosis.
Occupational dermatitis (embedded metal, scars, heat, light, soot, paraffin, coal tar, arsenic, aniline.)

DIFFERENTIAL DIAGNOSIS OF MALIGNANT NEOPLASMS

The differentiation of carcinoma, chancre, gumma, lupus vulgaris, and actinomycosis is usually not difficult. The duration of carcinoma is, as a rule, from one to ten years; of chancre, from one to two months; of gumma, from two to six months; of lupus vulgaris, since childhood. Chancre generally occurs in early adult life and gumma in middle age, whereas carcinoma occurs in older people. Carcinoma is usually a single lesion, while tertiary syphilis, lupus vulgaris, and actinomycosis form patches composed of multiple nodules. The common locations for cancer are on the face, especially the nose, and the dorsum of the hands, on the back, and the chest. Chancre is uncommon in these situations, occasionally appearing on the lips or at the tip of the index finger. Tertiary syphilis is common on the forehead, about the nose, and on the trunk, where its patches are distinctive on account of the multiple copper-colored nodules in various stages of evolution and involution arranged in a configurate manner, often in kidney-shaped or serpiginous patterns. In any one patch there may be active nodules or ulcerations, or some depressed, thin white scars produced by nodules which have involuted. The patches in lupus vulgaris are irregular, brownish-red, and scaly. They are often somewhat elevated and may be noticeably edematous. The patches are composed of soft, yellowish tubercles which have a characteristic tint suggesting apple jelly. In older lesions there may be ulceration or white, smooth, pliable scars. Active lupus lesions occur within the scars, a feature which is uncommon in syphilis. Actinomycosis is usually situated in the submaxillary or mandibular regions where it produces considerable induration, accompanied by fluctuating swellings and sinuses, and pus containing yellowish granular bodies. Clinical impressions of the diagnosis are confirmed in the case of carcinoma by histological examination; in chancre by dark-field examination, and often by the Wassermann reaction; in gumma by the histology and the Wassermann test; in lupus vulgaris by guinea pig inoculation, the demonstration of tubercle bacilli histologically,

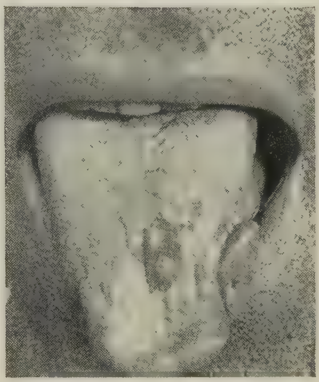

Fig. 878.—Syphilitic glossitis. Leukoplakia and carcinoma on lateral edge of organ.

and by the histological picture; in actinomycosis by the demonstration of the fungus in the exudate and in the tissue.

TREATMENT OF MALIGNANT NEOPLASMS

Prophylaxis.—It is likely that every skin cancer is preceded for a number of months or years by a benign lesion, the prompt removal of which would prevent the development of cancer. It is important in public health education, as well as in the profession, to emphasize the urgency of such prophylaxis.

Treatment of Squamous-cell Carcinoma.—Squamous-cell carcinoma of the skin is treated by various destructive, selective, and reparative methods, which are usually combined in any one case. Treatment should be prompt and thorough, with the aim to achieve complete eradication at one sitting. "It is unwise to destroy cancer piecemeal." Before entering into a discussion of these methods, it is desirable to entertain some preliminary considerations.

Cancer is such a serious disease and its treatment is so complicated that it is next to impossible for any one individual to deal adequately with its various phases. For this reason, treatment is best directed by a *group* of specialists —a surgeon, a pathologist, and a radiologist—working together.

Although a wave of prejudice has existed against the performance of *biopsy* on account of the alleged increase of the hazards of metastasis from such operative procedure, general experience confirmed by experimental work strongly indicates the error of these conceptions and the desirability of obtaining microscopical examination of at least lesions which are at all unusual or questionable in history or clinical appearance. The writer would go even further and venture the opinion that careful and thorough treatment can be given only when the information of the microscopical pathology is added to one's clinical comprehension of the nature of the lesion.

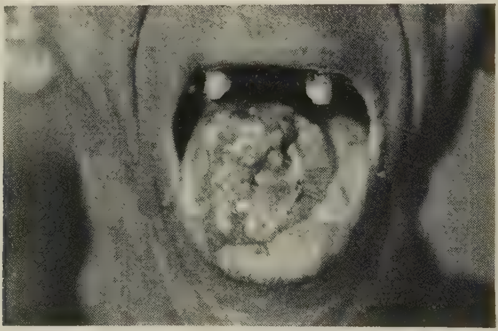

Fig. 879.—Cancer of the tongue, advanced.

Speed and accuracy are urged in the examination of the tissue. Good laboratories can now examine specimens in a few hours. There should be as little delay as possible in the rendering of a report. Waiting for days or weeks should not be tolerated, as the delay can only influence the patient unfavorably.

Specimens for microscopical examination may be removed with a minimum of trauma by the exercise of care and good judgment. When growths are small they should be widely extirpated and then examined. From large ulcerated or friable growths specimens may be taken without any anesthesia by using suitable scissor punches. The Keyes skin punch is best adapted for taking specimens from nodular or infiltrative lesions of firm consistency. Its use must be preceded by local freezing with the ethyl chloride spray. The cutting current of diathermy applied with a small wire-loop electrode is useful in removing sections from highly vascular growths, anesthesia being obtained by preliminary painting with 10 per cent solution of cocaine.

The method of *preoperative radiation* has passed through periods of interest, favor, and disfavor, the procedure causing now some confirmed advocates, and then some equally confirmed opponents. Naturally those in favor of the procedure belong largely to the group of radiologists, while the contrary position is held chiefly by surgeons. Preoperative treatments are recommended because many of the cells are thus destroyed, and the lymphatics draining the area are more or less obliterated, tending to prevent metastasis. Occasionally preoperative radiotherapy reduces the size of bulky growths so effectually that less operative treatment is required, and due to radiation effects, a better prognosis against recurrence is assured. The experiments of Murphy and his co-workers, at the Rockefeller Institute, on the influence of small doses of soft roentgen rays upon the resistance of mice to cancer grafts, have, to some minds, furnished a basis for the rationale of preoperative radiation. Students of radiation effects upon tissues concur in their support of this belief.

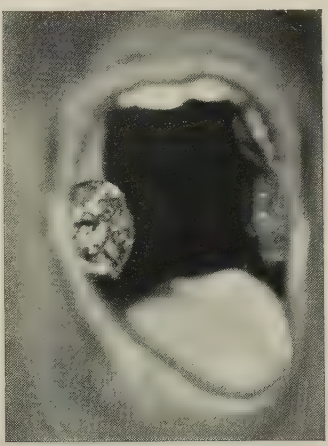

Fig. 880.—Carcinoma of the buccal mucosa.

Preoperative deep roentgen-ray treatments are not in more widespread use because of the difficulty of performing the routine technic before the time of operation, the slow healing of wounds, and the supposed increase of postoperative infections following such therapy.

In a general way, the treatment of cutaneous cancer may be divided into (1) *the handling of the primary lesion, and* (2) *the therapy of the drainage areas. To attain a recovery complete destruction of every cancer cell is imperative, for which reason an accurate determination of the extent of the disease is essential.*

Treatment of Primary Lesion.—The proportionate involvement of the bulk of the primary lesion by tumor tissue is so great that the conservation of normal tissue is of minor consequence, which means that a minimum of responsibiltiy need be placed upon the selective action of radiotherapy. Complete and radical surgical excision by a scalpel, cautery or by surgical diathermy is the most effective method of removal, but its results are strictly limited to the area of ablation and often yield unnecessary scarring and deformity.

Surgery.—This is the safest method of treatment, being most certain to remove the neoplastic disease, if it is possible to do so. Excision should be wide and deep and often it is necessary to obtain closure by the use of flaps or even full thickness grafts. Certain parts of the face may be treated with less scarring than is necessary in others, the eyelids and nose being particularly difficult situations. Surgical excision is the method of choice for the treatment of small tumors of undetermined cellular structure. It is much better to excise small lesions completely when it is desirable to study them microscopically than it is to remove a portion of them for biopsy. In advanced lesions which have resisted two or three intensive treatments by radiation, surgery is the court of last resort.

Surgery in conjunction with radiotherapy of the primary lesion is frequently advisable. In small circumscribed growths the combination sometimes reduces scarring to a minimum. Combined methods are also employed when the bulk of the primary lesion is so great, or infiltration is so extensive, that destructive treatment of the proliferating cells in the zone of invasion at the periphery of the tumor mass can be adequately administered only by preliminary removal of the bulk of the growth by some other means.

It is most important to emphasize that the cure of cancer is attained solely by the last fraction of the maximal destructive effect of any chosen method of therapy. Surgery and radiotherapy can, in some cases, be combined only by modifying each in respect to the other, or, in other words, by not obtaining from either method its fullest benefit. In such instances, it is usually better to use but a single method. It is not justifiable to base the combination upon conceptions of completeness and security rather than upon definite therapeutic indications, for in the treatment of cancer moderate methods, regardless of their multiplicity and combinations, do not succeed.

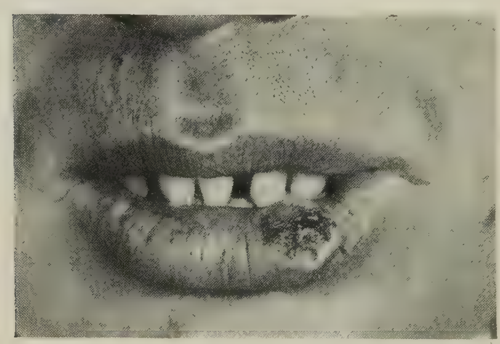

Fig. 881.—Epithelioma of lower lip.

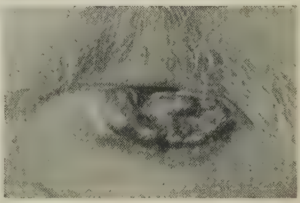

Fig. 882.—Ulcerated epithelioma of lower lip; fourteen months' duration. (Courtesy of Dr. Lester Hollander.)

Radiotherapy.—The majority of skin cancers can be cured by the use of *radium* or *x-rays*. These agents have an advantage over surgery because the results from a cosmetic point of view are superior. A minimal amount of scarring is desirable in the treatment of these lesions because 25 per cent of all skin cancers occur upon the nose and a large number are also encountered upon the eyelids. As stated, both of these situations are difficult ones to treat surgically without the production of objectionable scarring. The fact that most epitheliomas occur upon the face has led many surgeons of wide experience to prefer radium and *x*-ray treatment to surgery in the majority of skin neoplasms.

Obviously the radiosensitivity of tissue is an extremely complex phenomenon depending upon a large number of factors. The effects of radiation are determined by the morphology and physiology of the cell, and by the quality, intensity, and duration of the irradiation. Malignant tumors constituted of cells in which the reproductive power is the principal function, are, by this characteristic, made sensitive to the action of radiation. Because of this special radiosensitivity, generally much greater than that of normal tissues, certain cancers may be destroyed by radiation. But the different kinds of malignant tumors are far from possessing the same sensitivity to radiation, and it may be said that each cancer, defined by its biological and histologic characteristics, possesses a radiosensitivity of its own.[1]

Ideal radium therapy seems to require a nice adjustment of the relations between the destructive effect on tumor cells and stimulation of stroma cells. A large part of this effect, especially necrosis of single cells or large masses, in bulky or encapsulated tumors is caused by interference with the blood and lymph circulation.[2]

Regaud states: "The decreasing radiosusceptibility of cancer cells treated by small ineffective and successive doses, imposes the necessity of the single continuous or discontinuous treatment." And according to Ewing, "A high total dosage is the first essential in destroying most true carcinomatous processes and, as a rule, the most tumor destruction and tissue reaction, and the best results are obtained by delivering this dosage as soon as possible."

There are three principal methods of delivering this dosage:

1. The prolonged uninterrupted single exposure to a moderate intensity of hard radiation.
2. Smaller fractionated doses at intervals of two or three days and repeated in series.
3. The single massive exposure.

The continuous exposure is best adapted to inhibit growth with little damage to normal structures, being perhaps particularly suited to palliation of advanced cases. The fractional method is based upon the cumulative action of successive doses upon cells rendered vulnerable by cellular changes caused by previous doses. This effect is necessarily also harmful to the healing process, and destructive to the tissue defence reactions. Ewing believes this method accounts for most instances of abortive fibrosis, accomplishing growth restraint rather than actual cures. The single intensive dose which is adequate to devitalize all tumor cells and excite a severe reaction in the neighboring tissues, is most successful in establishing permanent cures in favorable cases. The radiosensitiveness of cancers decreases with successive exposures. Laborde and Roussy think that injury of the connective tissue stroma probably plays a part in this increased resistance.

The discussion of *radium therapy* of the primary lesion of squamous-cell carcinoma may be subdivided into treatment by external and interstitial radiation. In many cases it is advisable to use both, so that a devitalizing dose will be distributed throughout the entire lesion.

The source of the external radiation is preferably at a distance from the lesion to favor uniform depth effects. Filtration through 2 mm. of brass or its equivalent is expedient, causing almost entirely a gamma ray effect. The applicator should always be larger than the area under treatment, and shielding should be practically limited to the protection of neighboring vital structures. The trays described on pages 195 and 200 and the respective therapeutic doses may serve as approximate information for the student, but it is totally impracticable to give accurate details for treatment by radium because of the lack of uniformity of methods and the great variations in the lesions. In general, the doses tabulated for these trays are inclined to be too low rather than too high.

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[1] Laborde, S.: Notions générales concernant la Radiosensibilité des Tissus, J. de radiol. et d'electrol., 8: 260–291, July, 1924.

[2] Ewing, J.: Tissue Reactions to Radiation, Am. J. Roentgenol., 15: 93–115, Feb., 1926.

Table 33 gives the therapeutic doses in millicurie hours of a few commonly used applicators with filters of 2 mm. brass and 2 mm. rubber placed at various distances from the skin.

TABLE 33

	Applicator, size, cm.	Distance of application, cm.	Dose, millicurie hours
Rectangular	8 x 12	6	9000–12,000
	8 x 12	10	16,000–20,000
	4 x 6	4	2600–4000
	4 x 5	3	2500–3500
	2.5 x 1.7	1	700–1000
Round	4 diam.	1	1200–1500
Square	2 x 2	1	600–900

Interstitial radiation is especially suited to inaccessible and inoperable lesions, bulky tumors, or the deeply infiltrative types. In such lesions, a more homogeneous distribution of radium energy can be accomplished by this method than by any other. When radium in implants is inserted into the tissues the entire quantity of radiation, except that removed by the walls of the container, is utilized, whereas when it is applied externally, large portions of the radioactivity are dissipated into space. The required number of implants may be inserted to any depth at distances so arranged as to make use of concentric cross-firing from one to another, thus utilizing the entire amount of energy. The reader is referred to Chapter VII, where the technic for the use of interstitial radiation and rough indications for dosage are given.

Treatment of the primary lesion of squamous-cell carcinoma solely by *roentgen rays* is justifiable only in small circumscribed superficial growths less than a centimeter in depth; in other words, to growths amenable to removal by surgery, diathermy or radium, to all three of which methods roentgen therapy is inferior with the usual apparatus and technic used for dermatological purposes. A single massive exposure of radiation is preferable to repeated fractional dosage, although the latter has many advocates, who base their favor of the method upon repeated destruction of cells during mitotic periods. Apparently this advantage is more than offset by the increasing radiotolerance of tumors subjected to repeated small doses.

With effective voltages of 150 to 170 kv. and a filtration of $\frac{1}{4}$ mm. of copper, or 3 or 4 mm. of aluminum it is possible to obtain a fairly even dose to a depth of a centimeter. If softer radiation is used the upper portion of the tumor and the superficial layers of skin receive a therapeutic dose before the cells a few millimeters below get the same. For this reason, many of the so-called "cures" from unfiltered *x*-rays are temporary.

Adequate dosage for the treatment of squamous-cell epitheliomas with radiation is high. Practically no cures are obtained by less than 2 E. D. and sometimes 5 E. D. are necessary. Such dosage entails severe reactions and bad scarring, for the skin surrounding the tumor must be treated, as such growths extend into the lymphatics. Shielding with lead should generally be minimal, exposing an area of skin about the tumor at least twice as wide as the tumor itself. With large portals the effects of a given dose are much increased. The dose is modified by the size of the lesion, proximity of bone or cartilage and other features of the individual case.

The dose should not be repeated until the erythema reaction has disappeared, intervals between doses being usually six to ten weeks. Saturation effects, according to Kingery's studies, should be kept in mind. When lesions are convex or situated on the fingers, ears, nose or cheeks, advantage should be taken of cross-firing. This may consist of roentgen radiation applied through multiple portals or gamma radiation obtained from radium inserted into orifices in conjunction with roentgen therapy applied externally.

The status of *postoperative radiotherapy* has been aptly described by Pfahler. He says: "Postoperative radiation is now almost universally accepted as an advantage. It is based upon the theory that we are treating the remnants of the cancer which cannot be seen nor felt, and, therefore, have not been removed. The common recurrence of the disease following operation, excepting in the very early cases, shows that it is commonly impossible to remove the cancer cells totally. We have all seen the permanent disappearance of palpable and visible recurrent cancer under the influence of radiation. We have a right, therefore, to assume that if the disease will disappear when it has grown long enough to be seen and felt, similar tissue would disappear in the same manner if treated while it is of microscopical size only. . . .

"Postoperative radiation should be given as soon after the operation as is practical, which will usually be within from one to two weeks. Fractional doses seem to be preferable to massive doses, but they should be carefully measured and their cumulative value estimated. We should avoid atrophy, fibrosis, and telangiectasia."

Contraindications to Radiotherapy.—When an infected cancer is irradiated, it may be aggravated and assume a subacute character. Before radiation is applied the infection should be treated by wet dressings, antiseptics, or surgical means.

The proximity of cartilage or bone involves the possibility of necrosis of these structures, with resulting pain, the formation of sequestra, and indefinite delay of healing. Cancer involving cartilage usually cannot be satisfactorily handled by radiotherapy. Lesions located on the ears are preferably treated by other methods. This applies to a lesser extent to growths on the upper lids and nose.

Extreme debility, anemia, senility or very extensive involvement may sometimes contraindicate or modify radiotherapy.

Surgical Diathermy.—Surgical diathermy is occasionally a valuable addition to surgical methods, being employed in selected cases either as a substitute for, or an adjunct to, the scalpel or radiotherapy. It is particularly suitable for the treatment of roentgen-ray and radium cancer, and cancer arising upon lupus vulgaris.

Results in localized squamous-cell lesions from this method approximate those achieved in the treatment of basal-cell growths. The destruction must be thorough, for incomplete removal, even in an early stage, may sacrifice the possibility of cure. When surgical diathermy is used in the treatment of squamous-cell growths, the best results are obtained if gamma-ray or filtered x-ray therapy is applied after the coagulation. The judicious combination of surgical diathermy with operative surgery and radiotherapy is especially indicated when the growth is no longer localized.

For general technic the reader is referred to the chapter on Surgical Diathermy. Special indications and details are mentioned in the part of this chapter devoted to treatments preferable for lesions in various locations.

Other Methods.—The use of the actual *cautery* for the destruction or excision of cancer has given splendid results, notably in the hands of Percy, Bloodgood, Ochsner, Scott, and others. Cautery operations are especially indicated when the primary growth is infected, ulcerated, friable, or involves bone or cartilage, or is surrounded by scar tissue (lupus, *x*-ray skin) or is recurrent within scar tissue caused by treatment. When radium dosage has been unevenly distributed in tumors so that some parts are viable and others are overirradiated, cautery removal is the most satisfactory course, controlling at once the sloughing, bacterial contamination and pain, and offering the most favorable chance of cure.

Treatment by *arsenical paste*[1] or *zinc chloride paste*[2] is painful and not generally useful, but certain persistently recurrent, heavily irradiated, infected localized growths can be cured by no other methods. The *lead* treatment of cancer is still in the experimental stage and it is doubtful whether it will ever have any value in the cases which belong to the domain of dermatology. These interested in the status of this method will find some references in the bibliography.

Treatment of Drainage Area.—In the treatment of the drainage area every case must have individual consideration, and good surgical judgment combined with a wide experience in radiotherapy is prerequisite for proper handling. Invariably radiotherapy should be applied to the drainage areas of growths likely to metastasize. High voltage roentgen radiation is used in suberythema doses. Such treatment is usually repeated six or eight times at intervals of three or four weeks.

In cases of definite glandular involvement, neither surgery nor radiotherapy offers much hope of cure. If one or two freely movable glands are present, they may be dissected out by surgical methods, or treated by the insertion of gold or platinum implants, or radon or radium needles. When multiple indurated glands are present, they are generally best treated by repeated fractional doses of hard roentgen rays or by strong gamma-ray trays. If there is pain it is often relieved by the irradiation, through a reduction of the pressure on the nerves by the tumor. When radium is used in metastatic glands, it is advisable to administer the treatment about two weeks before or after a roentgen exposure, for there is danger of excessive reaction when these two forms of radiation are used simultaneously. Burrows is of the opinion that a roentgen dose of 50 to 60 per cent of the erythema dose can be given at the same time that radium tubes are buried in secondary glands, or 80 to 90 per cent erythema dose if applied six weeks later.

Morton states that squamous-cell cancers of the scalp and forehead do not usually require removal of the regional glands, but that in cancers of the face, cheek, ear, eyelid, chin and nose, and growths on the extremities and scrotum, the regional glands are frequently involved and should be removed.

Treatment of Paget's Disease.—When the diagnosis is definitely established the treatment does not vary from that of other primary squamous-cell cancers. In the borderline cases microscopical examination should invariably be made. Although the lesions may be very superficial clinically, under the microscope one may find deep extensions along the lymphatics and, with this possibility in mind, one should always treat vigorously.

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[1] De Rezende, C.: Sobre o Tratamento dos epitheliomas da pelle, Brazil-med., 40: 95–107, Feb. 20, 1926.

[2] Strobell, C. W.: Painless, Nondisseminating Chemical Removal of Inoperable Cancer of Breast and Axillary Nodes, with Report of the First Forty Cases, 1898–1920, New York State J. M., 21: 411–417, Nov., 1921. Remarkable Freedom from Local Recurrence Following Chemical Removal of Advanced Cancerous Breast, Ibid., 23: 27–29, Jan., 1923.

To perform complete mastectomy and axillary dissection upon all cases is, however, too radical; such treatment should be applied only in the more advanced clinically infiltrative cases or those with palpable glands. Most cases do not present these features and can be cured by radiotherapy with conservation of the breast. The radiation should be penetrating and distributed equally throughout the entire breast and axilla by dividing the skin over these parts into several squares, which are treated separately with 2 to 3 E. D. The local lesion should receive even larger amounts—4 to 5 E. D.

Treatment of Basal-cell Epithelioma.—In basal-cell epithelioma splendid results have been reported from treatment with *x*-rays, radium, and many other agents, but in judging these results it must be understood that practically all basal-cell growths are eradicated by any measure which destroys all the tumor cells in the locally affected area. The old crude method of thorough curettage followed by the application of strong caustics such as acid nitrate of mercury or trichloracetic acid, resulted in notable recoveries from large destructive basal-cell lesions. Therefore, there is no particular acclaim to be given those who have obtained benefit with *x*-rays, radium, or surgical diathermy in basal-cell epitheliomas. The author has seen these growths permanently removed by simple curettage in cases where repeated intensive exposures of *x*-rays had caused profuse atrophy, scarring, and temporary regression.

Credit, however, belongs to those who have destroyed extensive basal-cell growths, particularly those in which bone or cartilage was involved, by the skilful use of one or more of these methods. To these difficult cases that present many therapeutic problems most interest is attached, and yet their clinical variations are so numerous that it is totally impracticable to cover the therapeutic indications in more than a general way.

Basal-cell epitheliomas are treated by methods similar to but, on the whole, less drastic than those employed for squamous-cell growths. The object of the treatment is to destroy every cancer cell. In selected cases this can be accomplished by excision, surgical diathermy, powerful caustics, curettage, or irradiation by roentgen rays, or radium.

Surgical diathermy is preferred by the author in the majority of cases. It is not only a rapid, thoroughly destructive method but also leaves a minimum of scarring and is adapted to lesions in special locations where radionecrosis of cartilage or bone must be avoided. The entire diseased area is destroyed and curetted away. Thorough and skilful treatment should effect a recovery from all lesions except those which have extended to periosteum, cartilage, or bone, and even in these, spectacular results are achieved by this method alone or in combination with radium. The desiccating or coagulating currents are employed according to the volume and depth of the lesion. In occasional cases the cutting current is desirable. Before the application of treatment a biopsy should be taken by using a small wire loop on this electrode.

Radium therapy also gives excellent results with a minimum of scarring. Small lesions can be destroyed by radium with such perfect cosmetic results that it is impossible to detect the former site of the lesion. Comparable results may be attained by roentgen therapy, but the versatility and generally greater filtration of radium make it the preferred of the two agents. I have seen persistent nodules of the growth beneath the center of an atrophic patch produced by repeated intensive exposures of *x*-rays, but have never observed such recurrences beneath and in atrophic radium scars and believe this difference, which is of extreme importance in comparing the results of x-rays and radium on basal-cell growths, is due to the distribution of the absorption of the radium rays throughout of the tumor which is not possible with x-rays as ordinarily used, and which causes recovery under the most favorable auspices as regards damage to normal tissue. Of course, recurrences following radium treatment take place at the periphery of the atrophic radium patch but similar manifestations also follow all other methods and are due to inadequate dosage to the periphery of the lesion rather than a deficiency in the agent. Insufficient penetration and dosage, and poor approximation are the most common errors in radium technic. The small amounts of radium owned by most dermatologists and the fear of x-ray sequelae, ever present in their mind, in the treatment of other dermatoses seem to have exerted a restraining influence upon their conceptions of radium dosage in epithelioma.

Upon small lesions the best results are obtained by a flat gamma-ray applicator employed from a distance of 1 cm. The applicator should always be larger than the size of the lesion and when this is unusually extensive an increase of distance to 3 cm. is advisable. Experience has shown two sizes to be especially adapted for use. The smaller of these is oblong, 1.8 x 1.2 cm., and the larger is round, 3.5 cm. in diameter; both are filtered through the equivalent of 2 mm. of brass. They should be used in doses which produce sharp reactions when applied at a distance of 1 cm., the dose of the former being 700 to 800 millicurie hours, and that of the latter 1200 to 1400 millicurie hours. Doses for trays of other sizes and shapes are given in Chapter VIII on page 195.

The use of silver tubes embedded in dental modeling compound is less effective than gamma-ray trays. Small growths (less than 1 cm. in diameter) may be handled by a single tube giving a dosage of 70 or 80 millicurie hours, and for larger lesions multiple tubes should be so distributed that each square centimeter of the surface of the lesion is given a dose of 60 to 70 millicurie hours when less than five tubes are employed, or 55 to 65 millicurie hours when the number of tubes is greater. The use of flat applicators should be limited to extremely superficial keratoses or basal-cell lesions, and they should be unfiltered or filtered according to the depth of the involvement. The dosage should produce an intense reaction, which may be accomplished by the commonly used 10 mg. flat glazed applicator, 2 cm. square, half-strength, unfiltered, for an exposure time of two to four hours, and when filtered through 0.5 mm. of silver, from ten to twenty hours. For the dosage of other flat glazed applicators, and other filtrations the reader is referred to the tables given in the chapter on Radium.

In occasional cases, interstitial use of implants or needles has special advantages, particularly for small nodules in inaccessible locations.

Intensive exposures of either filtered or unfiltered *x-rays* suffice for recovery in the majority of easy cases. Filtration is especially indicated in extensive thick lesions extending well down into the derma or subcutis, and the trend seems to be toward greater filtration in all varieties. Two full erythema doses will cure, at least temporarily, most basal-cell lesions, but this amount is rarely given because most operators forget that with small portals the dose is reduced considerably. Although 2 to 3 E. D. are the average for unfiltered treatment, as high as six may be indicated when the portal of entry is small, the lesion is bulky or the patient is senile. Filtered dosage ranges between two and four erythema exposures, which require fifteen to thirty minutes if 9-inch spark gap, 5 ma., 3 mm. aluminum filter at 10-inch distance are used.

Treatments are repeated after the subsidence of the visible reaction, usually at intervals of four to eight weeks, and are continued until the disease has been clinically eradicated. If the cure does not result in three or four treatments, resource to other methods is preferable to a continuation of roentgen therapy.

Fractional treatment of basal-cell epithelioma is still employed by some radiologists, but the intensive treatment is preferable for reasons stated in the early part of this chapter. Growths which have received repeated small doses of radiation acquire a tolerance to it, and this makes them so recalcitrant to further radiotherapy that it is advisable to use some other method for their treatment. Surgical diathermy is an advantageous procedure in these cases.

A *combination of surgical methods with radiotherapy* is effective in most cases. Until the surgical diathermy became popular, curettage of the lesion was generally used. This method has its advantages in experienced hands, for the operator can see and feel the extent and remnants of tumor tissue in a manner that is not possible during desiccation or coagulation. Preliminary destruction by the latter method is bloodless, rapid, and easy. Preference for either method lies largely with the individual operator. Belot employs the equivalent of 2 to 3 E. D. (10 to 15 Holzknecht) of unfiltered *x*-rays, preceded by curettage, or, if curettage is not done, a filtered dose. The advantage of preliminary curettage or electrothermy is that it destroys the bulk of the lesion and decreases the amount of radiation required to effect a cure. Regardless of the method used, thoroughness is essential, for, although basal-cell lesions are unlikely to metastasize, mistakes in diagnosis are certain to occur unless the microscopical report is received in each case before the administration of treatment.

Recurrences after unsuccessful or incomplete treatment are best handled by the actual cautery, surgical diathermy, or interstitial radiation. At times, a combination of these procedures should be used. Of course, many recurrences can be dealt with by external radiation or very simple moderate treatment, but interest attaches itself to the more difficult cases which have resisted intelligent efforts toward eradication, and in these the actual cautery or surgical diathermy, sometimes combined with interstitial radiation, or chemical paste, is the most effective treatment. The radiosensitiveness of cancer decreases with successive irradiations.

Modifications in Treatment According to Topography.—Epitheliomas on the *external ear* are difficult to identify clinically as basal-cell or squamous-cell lesions, and are also difficult to treat as the skin lies very close to the cartilage. "Even if the latter escapes direct cancerous involvement, the chronic inflammatory changes to which it is subjected, together with the poor blood supply, prevent prompt healing, even after the removal of the parent cause of the trouble."[1] The possibility of necrosis of cartilage from radiotherapy gives surgical methods of treatment a preference in these lesions. Excision by the scalpel or the diathermic cutting current should remove the lesion by a wide margin. The actual cautery is also an excellent agent in extensive or frankly malignant cases.

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[1] Sutton, Richard L.: Carcinoma of the External Ear, J. A. M. A., 74: 88–90, Jan. 10, 1920.

The method of treatment varies according to the bulk, depth, and character of the lesion, early and radical removal by some surgical method being best for squamous-cell growths. The basal-cell tumors are less serious, and more consideration can be given to the cosmetic results when they are being treated. Prior to the involvement of the cartilage, many of the basal-cell lesions respond very satisfactorily to radiation. Radium is preferable to roentgen therapy, being best applied in silver tubes in dental modeling compound so arranged anteriorly and posteriorly that there is cross-firing through the substance of the lesion. In the treatment of basal-cell carcinoma of the ear by means of radium, a severe reaction is seldom necessary, and in the superficial cases should always be avoided. The dosage should be between 50 and 60 millicurie hours per square centimeter of surface area. In those cases presenting cartilaginous involvement, both radium and roentgen-ray treatment are useless.

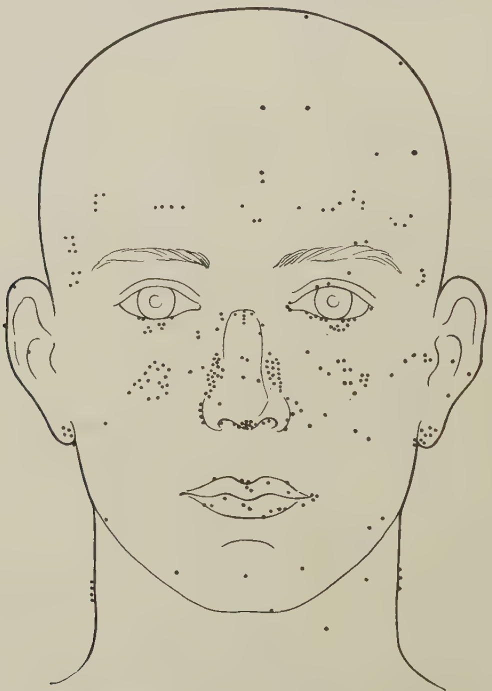

Fig. 883.—Location of 260 epitheliomas of the face treated at the Vanderbilt Clinic, including all types.

Microscopical examination should be made after complete removal in most cases, although in ulcerated lesions a preliminary biopsy does not entail increased hazard and may give information which will modify the treatment.

Squamous-cell cancer of the ear may metastasize to the auricular, preauricular, parotid or cervical lymph glands. These drainage areas should be routinely irradiated in all cases of squamous carcinoma of the external ear, and when there are palpable metastases these should also be treated surgically or by the insertion of gold radon implants. Secondary infection in these cases may lead to chronic inflammatory adenitis, which is difficult to distinguish from cancerous invasion of the glands.

Cancer of the *auditory meatus* is usually of the basal-cell type and is best eradicated by radium therapy. The exact method of application is governed by the characteristics of the individual case. When the canal is sufficiently patent to permit the introduction of a silver tube into the lumen, this source of radiation is most effective. When the growth is deeply situated or bulky, emanation should be buried in it. This is preferably contained in platinum needles, or gold or platinum implants to avoid the necrosis and pain caused by bare seeds.

Cancer of the *eyelid* or *canthus* requires special consideration. The necessity of thorough, prompt treatment must be borne in mind because of the danger of extension of the growth into the orbit. Surgical excision of epithelioma of the eyelid causes unwarranted deformity which is not correctible by plastic operation. Radiotherapy must be employed with extreme caution in these locations on account of the danger of injury to the eyeball or lid cartilage.

Del Buono has reported good results from soft and supersoft rays on superficial skin cancer. Such treatment is particularly advantageous on lesions near the eye, in which location the *x*-rays possess some of the virtues of unfiltered radium rays. Surgical diathermy has special advantages in meeting these difficulties and is preferred at least as a preliminary measure in the treatment of most basal-cell neoplasms in this region. After thorough removal by desiccation or coagulation the remnant of destroyed tissue is removed by a dull curet. This ablation of the lesion diminishes the dosage of radium necessary or makes it entirely superfluous. In general, basal-cell lesions thus treated should be given an exposure of lightly filtered or unfiltered radium, in the use of which there is the least danger to the eyeball, because of the decrease in its intensity afforded by a small distance. The unfiltered bulb is valuable for the treatment of eyelid lesions, its intense soft radiation making the application rapid and effective without endangering underlying structures. Whenever radium is applied the eyeball should be protected by a lead screen from 0.5 to 1 mm. in thickness made to fit the contour of the globe of the eye and large enough to extend into the conjunctival fornices. This lead plate is covered by a sheet of rubber and is dipped in melted paraffin.

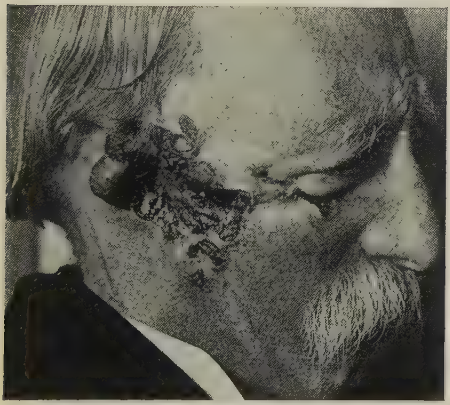

Fig. 884.—Rodent ulcer, causing destruction of ear and part of cheek. (Courtesy of Dr. Nathan T. Beers.)

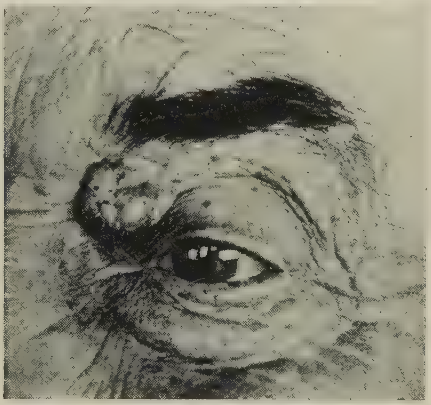

Fig. 885.—Basal-cell epithelioma of canthus.

When dry it is greased with vaselin and inserted between the eyeball and eyelids.

If the lesion involves the canthus, the insertion of a single gold implant may be sufficient to eradicate that part of the growth. When the tarsal cartilage is invaded the entire lid must usually be removed as radiation is valueless in such cases. In the event of extension into the orbit, enucleation of the eyeball is nearly always necessary. The operation is followed by radium used interstitially or in a mold of dental compound with a dose of 55 to 65 millicurie hours is given to each square centimeter of surface by silver tubes of 0.5 mm. wall thickness. If the bone is involved, the eye should be removed and the diseased bone destroyed by the cautery in operable cases. At times heavy external radiation from gamma-ray packs is advantageously given in conjunction with these other forms of therapy.

Squamous-cell carcinoma of the eyelid is handled along more drastic lines than described above, the best results being from radium treatment. The infiltrative character of this type of growth makes inadvisable the caustic exposure of soft radiation used on basal-cell tumors in this location. Preferably the radium should be filtered and given in sufficient dose to produce a vigorous reaction. The bulb may be filtered through 2 mm. of brass, silver tubes in dental compound may be molded over the growth, or a flat gamma-ray applicator or tray may be employed from a distance of 1 to 3 cm. as the requirements of the individual case may dictate. In any event the eyeball should be protected from injury in the manner previously described. Metastatic glands should be excised or treated by radiotherapy.

Cancers of the *scalp* and *forehead* are close to the skull, and the proximity of the bone to the lesion modifies the therapy. Heavy doses of radiation are contraindicated by the danger of necrosis of the periosteum or bone. In the use of electrocoagulation care should also be exercised to avoid, as far as possible, bone destruction, which delays healing indefinitely. Most carcinomas of the scalp and forehead can be readily handled by either radiotherapy or surgical and electrothermic measures if these precautions are recognized. In general, it is not necessary to treat the lymphatic glands draining squamous carcinoma of these areas.

Carcinoma of the *nose* forms at least 20 per cent of skin cancers, being most frequent at the tip.[1, 2] Basal-cell lesions are as a rule easily eradicated, unless the cartilage or perichondrium is involved or there is evident damage to the contiguous tissues from previous irradiation or the unskilled use of escharotics. There is little preference in the methods of treatment for the smaller lesions, recovery being achieved equally well by roentgen rays, radium, electrothermy, curettage and caustic, the actual cautery and the scalpel. For the most part, the best cosmetic results follow radiotherapeutic measures.

The rather superficial character of these growths and the proximity of cartilage may account for the preference for unfiltered or lightly filtered roentgen rays, or lightly filtered radium. With roentgen therapy 2 to 4 E. D., unfiltered, are advisable, the larger dose being applied to very elderly patients. When radium is used, flat glazed applicators in contact with the surface are usually sufficient. They may be applied unfiltered, or filtered through 1 mm. aluminum or 0.5 mm. silver, according to the depth of the involvement. The

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[1] Sutton, R. L.: A Clinical Study of Carcinoma of the Nose, J. A. M. A., 77: 1561–1563, Nov. 12, 1921.

[2] Broders, A. C.: Basal-cell Epithelioma, J. A. M. A., 72: 856, Mar. 22, 1919.

dosage should evoke a sharp reaction with exudation, which results from an exposure of three or four hours, a half-strength applicator, unfiltered, being used, or from an exposure of ten to twelve hours with the same applicator filtered through silver. Details of dosage may be found in the chapter on Radium. Silver tubes containing radium salt or emanation and in a mold of dental compound are of great convenience for treating such of these lesions as project. More extensive growths may be handled favorably by the small gamma-ray applicators at a distance of 1 cm., in which case damage to the eye or nasal cartilage should be avoided by shielding and moderate dosage.

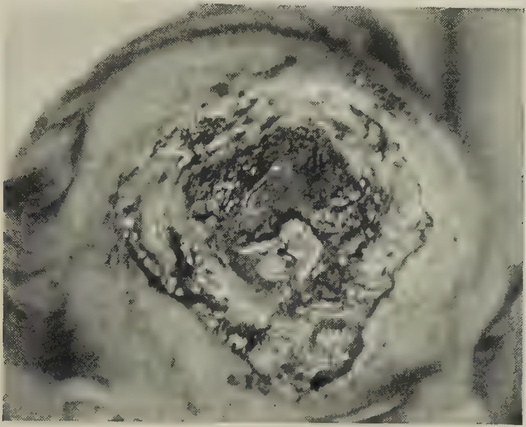

Fig. 886.—Large epithelioma of scalp, basal-cell type. Eighteen years' duration. In the base of the ulcer the dura mater was visible and movements of it due to the pulse could be observed. (Courtesy of Dr. Lester Hollander.)

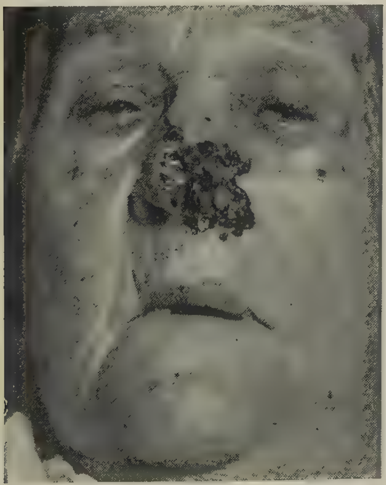

Fig. 887.—Rodent ulcer, showing destruction of nose caused by it. (Courtesy of Dr. John S. Horsley.)

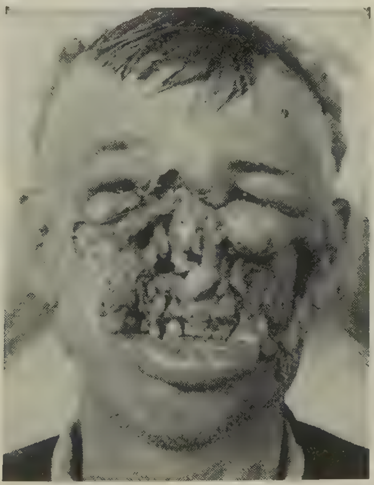

Fig. 888.—Squamous-cell carcinoma of nose, causing great destruction. Note glandular enlargement at angle of jaw. Duration, eight months. (Courtesy of Dr. Lester Hollander.)

Preliminary curettage, prior to radiotherapy or destruction by desiccation or the actual cautery, is frequently advocated. There may be some grounds for the belief that such combined treatment is more thorough and gives the best cosmetic results. Sutton feels "after long and diverse experience with all sorts and methods of treatment, that curettage, immediately followed by the application of liquor hydrargyri nitratis, as originally recommended by Sherwell, neutralized, three minutes afterward, with sodium bicarbonate, with subsequent radium therapy, is the most satisfactory and dependable."

When cartilage or perichondrium is involved or the tissue contiguous to the tumor has been devitalized by previous unsuccessful treatment by radiation or escharotics, the diathermic cutting current, throttled down so that it cuts slowly and neatly without charring, has no equal. Extensive lesions requiring this treatment are usually located on the ala nasi or in the nasolabial groove. Under novocaine adrenalin anesthesia they are thoroughly removed, and it is surprising how well the defect closes over in the course of a few months so that real deformity is seldom caused even by resection of the entire ala. Larger defects of course should be covered by skin grafts after a free interval of two years.

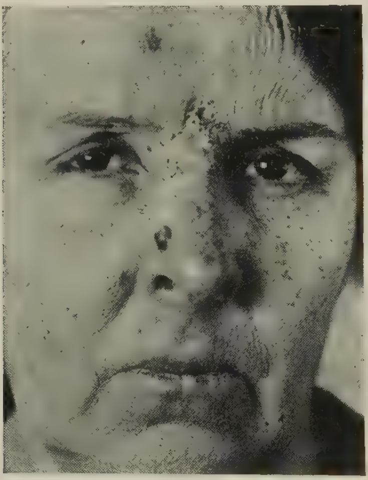

Fig. 889.

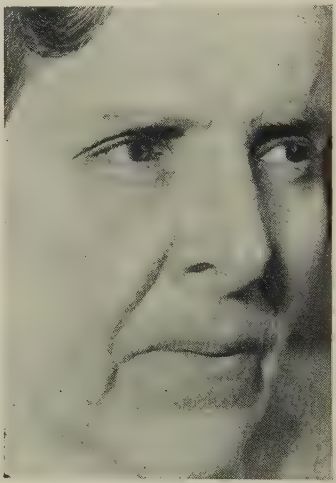

Fig. 890.

Figs. 889, 890.—Superficial type of basal-cell epithelioma of the nose. Before and after treatment by *x*-rays.

The treatment of squamous-cell carcinoma of the nose has been successfully accomplished by many therapeutic methods. In general, as upon other parts of the integument, there is a preference shown radium therapy, although a large number of the profession favor other agents. The advantages of radium treatment are the extension of its effects outside the area actually destroyed, minimal scar formation, and scarcity of recurrences.

Gamma-ray flat applicators should be used on lesions of this character, preferably applied from a distance of 1 or 3 cm. The dosage should provoke an intensely erythematous and exudative reaction not only in the lesion, but well outside its evident edge. The details of dosage have been previously given. Silver tubes in dental modeling compound, although less effective, may be substituted for this method.

The treatment of cancer of the *lip, tongue*, and *buccal surfaces* is a special field of study outside the scope of this book.

Cancer of the skin of the *cheek* or *chin* is readily amenable to therapy in all except very advanced cases or those complicated by damage to the skin from chronic inflammation or previous unsuccessful treatment. Average cases may be cured by several of the methods which have been described for the treatment of cancer. Interest attaches itself to the cases of extensive involvement, not infrequently attacking the periosteum or bone, and to those cancerous conditions arising upon lupus or radiodermatitis. Surgical methods of treatment, especially the diathermic cutting current or cautery knife, are preeminently valuable in this group of cases. Extensive resections which could not be done by the scalpel are feasible with this technic. Such treatment is sometimes supplemented with advantage by the interstitial use of radium and proper treatment of the draining lymphatics.

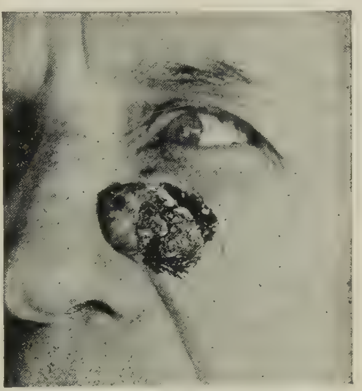

Fig. 891.—Ulcerated basal-cell epithelioma in a common location.

Cancers of the male and female *genitalia* have a tendency to be highly malignant, although occasionally they run a protracted mild course. Cancer of the vulva, and of the penis which has extended to the cavernous erectile tissue, is nearly always fatal. In the latter case, the growth may be considered superficial until it has penetrated Buck's fascia, which is a fibrous natural barrier. As Dean has pointed out, "If the growth is superficial and Buck's fascia is intact, we expect surface irradiation alone to result in a permanent regression. The applicator employed is made from an impression of the tumor in dental modeling compound. Radium emanation tubes of approximately equal strength, encased in cylinders of silver 0.5 mm. thick, are arranged in the mold so that they will be 1 mm. from the surface of the lesion. The usual dosage is 65 millicurie hours to each square centimeter of tumor surface.

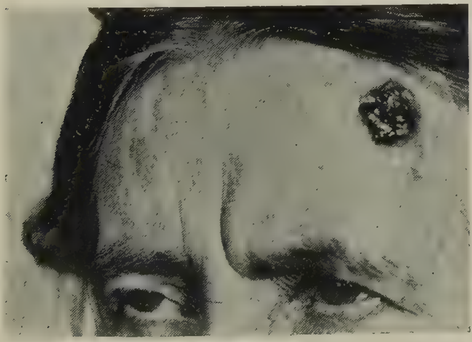

Fig. 892.

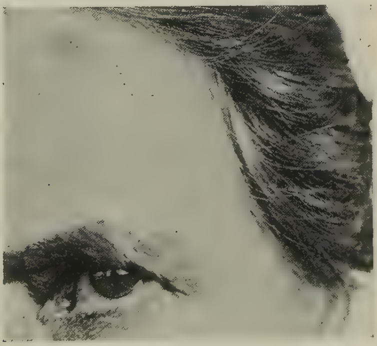

Fig. 893.

Figs. 892, 893.—Basal-cell epithelioma of the forehead. Before and after x-ray treatment.

"If the deeper structures of the organ have become invaded by extension of the disease, we apply the same type of treatment but increase the dosage in proportion to the depth of tumor tissue. Then, after sufficient time has elapsed to permit the effects of the irradiation to become established, usually two to four weeks, amputation is performed in a plane 1 to 2 cm. from the proximal edge of the tumor."

Cancer of the scrotum is practically always of the squamous-cell type, occurring in many instances from chronic irritation from paraffin, soot, and oils used for lubrication. The lesion begins as a warty outgrowth, which may involute spontaneously, or, after persisting for many years, may develop into a papillary ulcerative or metastatic growth.

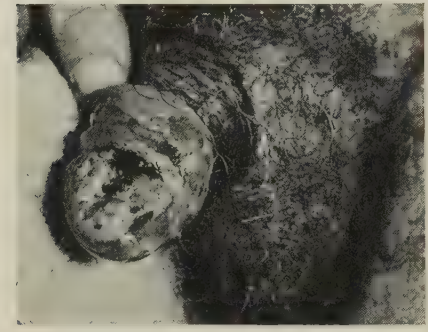

Fig. 894.—Carcinoma of the glans penis.

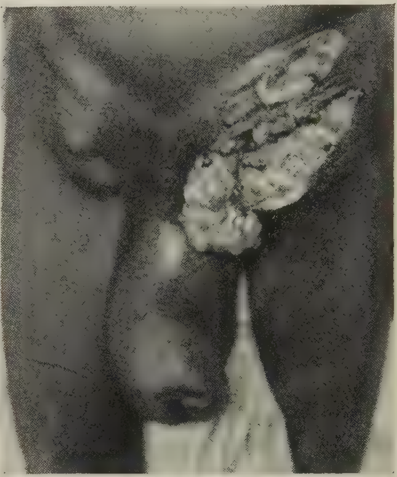

Fig. 895.—Carcinoma of the glans penis, with ulcerating inguinal adenitis. Note edema of foreskin. (Courtesy of Dr. Lester Hollander.)

The treatment should be wide extirpation followed by intensive radiotherapy, both locally and to the site of the regional glands, after resection.

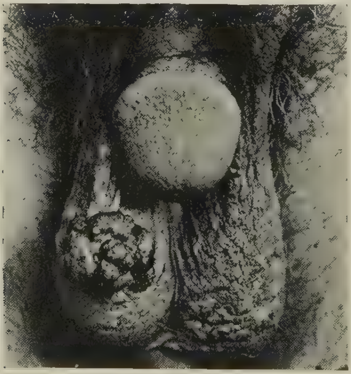

Fig. 896.—Papillary carcinoma of the scrotum.

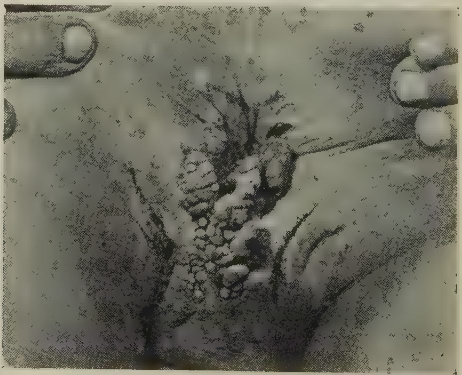

Fig. 897.—Carcinoma of the rectum. Note papillary character. (Courtesy of Drs. J. B. and Bedford Shelmire.)

Cancer of the extremities is frequently composed of squamous cells. It is common on the backs of the hands, but rare on the legs. The lesions in their early stages respond to treatment almost as favorably as basal-cell growths. Radium therapy is the preferable method, although wide extirpation by the scalpel or electrothermic current is equally successful. After removal by these latter methods, the site of the lesion should be irradiated. The regional lymphatic glands should be resected and the region treated by x-rays. Deeply infiltrating growths are occasionally best dealt with by the interstitial use of radium emanation or by radical amputation.

Cancer of the digits is almost invariably squamous cell. Although prompt involution not infrequently follows intensive radiotherapy, surgical removal far above the lesion should be undertaken without delay in practically all cases. In addition, the axillary or inguinal regions should be dissected and receive high voltage roentgen therapy or radium treatment.

Treatment of Melanoma.—Prophylaxis is the important consideration in the treatment of melanoma.[1] This is accomplished most effectively by wide surgical excision or thorough electrocoagulation of all pigmented moles which are subject to friction, pressure, or other forms of irritation, preference being for the former method, except where it entails unsightly scarring.

After malignancy has developed, treatment is generally ineffective, often apparently hastening dissemination. In some cases, however, in the early stages marked regression or even cures have been obtained, and for this reason therapeutic measures should generally be undertaken. Although wide surgical excision has general preference in this country, the objections to it are the frequency of local recurrences and the danger of metastasis. The recurrences of melanoma which are sometimes manifested within the scar after surgical excision, apparently are not observed after intensive radiotherapy. For this reason radium and x-ray therapy of the primary lesion seem to possess a definite local value. In early cases, massive doses of roentgen rays or radium rays occasionally have been curative, and in extensive lesions with adenopathies they are probably preferable to other forms of therapy.

Small metastatic cutaneous nodules may be destroyed by the insertion of radon in gold or platinum implants, or of needles containing the salt or emanation. Nevertheless, the results in the treatment of melanoma are almost uniformly disappointing, the disease spreading rapidly and causing death. Recurrences sometimes appear as late as ten years after apparent cure.

Treatment of Sarcoma.—The response of sarcoma to radiation varies widely in accordance with its structure. A lesion composed mostly of lymphocytes is extremely sensitive, whereas one formed of spindle cells is highly resistant. The rapid disappearance of the primary growth, especially in lymphosarcoma, should not be regarded with too great an importance and the patient should be observed for a long period, for metastases are likely to occur suddenly and progress rapidly. Separate metastases may be successfully dealt with, but widely disseminated recurrences eventually lead to a fatal termination. Relief of symptoms and prolongation of life are achieved in most cases and some patients remain free from the disease indefinitely. As pointed out by Laborde, the sensitivity decreases as the constituent cells are further differentiated from the embryonic state, elaborating paraplasmic substances.

As a rule, primary localized growths should be widely excised. If an operation is impracticable because of the location, extent, or metastasis of the lesion, radiotherapy can be applied usually with benefit, the interstitial use of radium or radon being especially valuable.

The treatment of Kaposi's multiple pigmented hemorrhagic sarcoma requires prolonged use of external radiation. Fractional roentgen therapy, preferably filtered, is the method of choice. This treatment causes the involution of the tumors, but does not prevent the development of others. The dosage should be kept below an erythema in order to avoid radiation sequelae. Arsenic, preferably sodium arsenite solution hypodermically, should be given simultaneously, the administration being pushed to the limit of tolerance. In the late stages of the disease, if malignant spindle-cell sarcoma develops, it should be treated by radon implants.

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[1] The reader is referred to Chapter XXVIII, pp. 848–853, and to the first part of this chapter.

End-results in the Treatment of Cancer.—There are relatively few statistics upon the results of treatment of skin cancer, and these are complicated by variations in the location and structure of the growths, diversity in the methods of treatment, and in the length of time patients remained under observation and free from recurrence.

A series of 265 cases of skin cancer treated by radium at the Huntington Hospital, Boston, has been analysed by Deland. The cases were treated during 1917–18, the results of treatment judged by the condition of the patient at the end of three years being ascertained in 203 cases. Of these, 144 were over sixty, with a slight preponderance of men over women. The average patient recalled having some minor antecedent defect in the skin for many years (warts, moles, papillomas, or keratoses). The results of all cases give 62.5 per cent of three-year cures by radium alone, and 4.4 per cent more by operation following radium; the early cases showed 81 per cent of apparent cures by radium and 3 per cent by operation following radium; the moderately advanced cases, 38.4 per cent by radium, and 10 per cent by radium and operation. None of the advanced cases recovered because of radium, and only 3 per cent from surgical removal following irradiation.

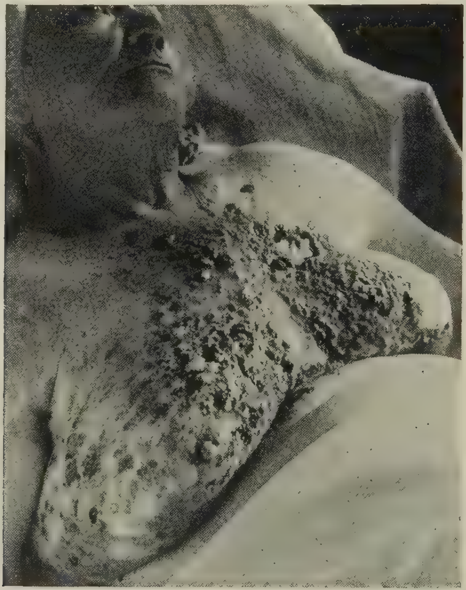

Fig. 898.—Metastatic nodules and ulcerations of skin from scirrhous mammary cancer. (Courtesy of Dr. L. W. Haynes, Grasslands Hospital.)

In cancer of the nose alone, there were 44 apparent cures in 57 patients; when it involved the adjacent structures, there were 10 out of 17 cases. The ear cases showed 9 well of 12 treated, but when the disease spread from the ear to surrounding tissues the patients all died. The eye cases were the most satisfactory of all, there being 25 recoveries out of 30 cases, with only one death. The other large group of patients, those in whom the cheek was involved, gave 26 free from disease out of 41 possibilities.

Burrows summarizes the statistics of cases from the Manchester and District Radium Institute, giving results two to nine years after treatment. Of 420 rodent ulcers treated by radium, 303 or 73 per cent remain well; 11 of those which invaded bone or cartilage failed to respond to radium and were removed by diathermy. After apparent cure there were 5 per cent of recurrences, of which one half were permanently eradicated by further treatment. Recurrences were most frequent on the angle of the nose and on the temple during the first three years. Failures are most frequent in lesions involving the orbit or the ear.

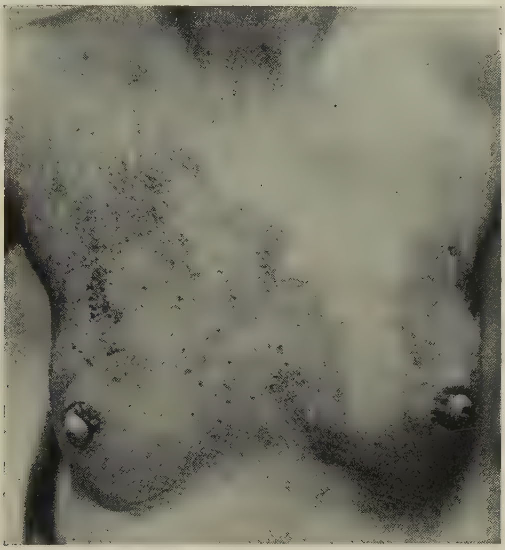

Fig. 899.—Diffuse carcinomatosis, inflammatory type, involving both breasts. Note nodules in the lymphatics. (Courtesy of Dr. H. W. Barber, London, England.)

Squamous-cell carcinoma of the skin showed 52 per cent apparent cures after an interval ranging from two to nine years. The series contained 147 cases, of which 26 or 18 per cent developed secondary deposits. He found it exceptional to cure a case which had developed glandular metastases.

MacKee, from a total of 282 cases of basal-cell epithelioma observed from periods of six months to nine years, had apparent cures in 87 per cent; 36 cases being followed for three years, during which there were 8 recurrences —83 per cent recoveries.

Lunsford and Taussig summarize the cases treated at the University of California Medical School, between 1920 and 1926, as follows: "Of the 109 skin cases, 89 basal-celled epitheliomata show a 67 per cent recovery, and 20 squamous-celled epitheliomata show a 55 per cent, one to five year cure."

Stevens gives one to five years' statistics, estimating 142 clinical recoveries in 145 cases of basal-cell and 34 clinical recoveries in 51 cases of squamous-cell epithelioma. Treatment was administered with radium, roentgen rays, and electrothermic coagulation.

Dautwitz reports the results of 186 cases of skin cancer treated by radium. In the previously untreated cases there were 70 per cent clinical cures lasting over three years, whereas in the group previously treated by irradiation or sugery only 50 per cent had similar freedom from the disease.

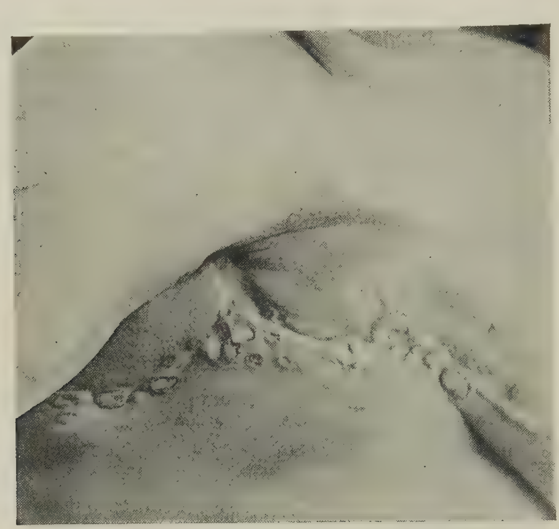

Fig. 900.—Carcinoma of the breast. Recurrences along operative scar. (Courtesy of Dr. Nathan T. Beers.)

It is probably safe to say that the curative factor in skin cancer is decidedly better than in almost any other form of cancer and that, but for early operative interference, often for cosmetic reasons, the mortality would be much higher. Hoffman gives the following results of the San Francisco Cancer Survey:

Mortality from Skin Cancers, San Francisco, 1920–1927

Rate per 100,000 of Population

	Total:		Male:		Female:	
	1920–1923	1924–1927	1920–1923	1924–1927	1920–1923	1924–1927
Ear	0.6	0.1	0.6	0.2	0.6	
Face	0.9	1.1	0.9	1.1	0.8	1.2
Head	0.2	0.1	0.1	...	0.2	0.3
Nose	0.5	0.1	0.6	0.1	0.2	0.2
Others	0.8	0.2	1.1	0.4	0.5	
	3.0	1.6	3.3	1.8	2.3	1.7

He states: "In the above tabulation I have been able to differentiate several special forms of skin cancers, or, specifically, of the ear, face, nose, and head. The rates for San Francisco for skin cancers declined from 3 per 100,000 during the first four years to 1.6 during the last four years. The decline in the rate is much more marked for males, among whom the rate declined from 3.3 during the first four years to 1.8 during the last four years. This affected every form of skin cancer except cancer of the face, which shows a slight increase. For the female population during the two periods the rate declined from 2.3 to 1.7. How far this gratifying result is the consequence of better and earlier treatment is, of course, an open question, but at the same time a reasonable inference."

Therapeutic success is modified by many factors. Previous unsuccessful treatment diminishes the likelihood of complete regression. Ulceration infection and involvement of cartilage, bone, or mucous membranes lead to poor results. Prognosis is modified unfavorably when the base of the lesion is adherent to underlying structures, or when there are extensions into the regional lymph nodes. In general, early lesions do better than those of long duration, and basal-cell lesions better than those composed of squamous cells. Prognosis is also affected by the radio-resistance of the tumor cells and the extent of the protective reaction against the growth, by the degree of malignancy of the tumor, by insufficient dosage, especially to cells at the periphery of the lesion, and by neglect of adequate observation after complete clinical regression.

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CHAPTER XXXI

THE LYMPHOBLASTOMAS

In this group are included several diseases of lymphatic origin which manifest themselves in diverse clinical ways. The various expressions and their interrelationships are as yet little understood; but the cutaneous lesions, aside from those of toxic origin, are generally accepted as hyperplasias of hematopoietic tissues, which vary from one another chiefly in their degree of differentiation. The cutaneous infiltrations usually occur in association with general neoplastic disease of the blood-forming system. There is some evidence, however, which suggests that infections may have a predisposing relationship to these processes.[1]

Identification of the process is based upon the pathology. The lymphoblast is the characteristic cell of the lymphoblastoma; and its derivatives, the lymphocytes, although varying considerably among themselves, are in general small round cells. As pointed out by Keim, the distinctive features of cells of the lymphocytic series are not particularly striking even under normal conditions and are even less so in tumors originating from lymphoblasts. The stroma consists principally of preexisting vessels, and connective tissue stimulated to active proliferation, sometimes with many fibroblasts and inflammatory cells such as eosinophiles and plasma cells, so that the infiltrating tumor growth simulates inflammatory tissue such as is encountered in chronic infection. The lymphoblastomas spread through the lymphatics and form metastases in the viscera and in the blood stream, as well as in the skin. The term "lymphatic leukemia" is applied to the growth of lymphoblasts in the circulating blood.

Another view is that cutaneous infiltrations of this kind are due to autochthonous development from small cellular foci usually present in the skin which proliferate in reaction to a circulating toxin. In other words, according to this conception, the specific skin changes are not due to migrations of cells, but to the local proliferation of cells derived from the vascular system.

Confusion exists in the classification of these processes and there are many synonymous terms in use, as well as a variety of meanings to any one of them. Minot and Isaacs include under the general heading "lymphoblastoma"—a name considered by some as synonymous with malignant lymphoma—the following terms: lymphatic leukemia (lymphocytic and lymphoblastic), aleukemic lymphatic leukemia (pseudoleukemia, aleukemic lymphadenosis), lymphocytoma, Hodgkin's disease (lymphogranuloma), lymphadenoma, lymphomatosis, lymphosarcoma, round-cell sarcoma, leukosarcoma, and lymphadenosarcoma. Such conditions as Banti's disease, chloroma, and Mikulicz's disease may also be included.

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[1] Reed, D.: On the Pathologic Changes in Hodgkin's Disease with Especial Reference to Its Relation to Tuberculosis, Johns Hopkins Hosp. Rep., 10: 133, 1902. Ewing, J.: Discussion, Scientific Proceedings of the Twenty-seventh Annual Meeting of the Amer. Assn. Pathologists and Bacteriologists, Am. J. Path., 3: 551, Sept., 1927. Longcope, W. T.: On the Pathologic Histology of Hodgkin's Disease with a Report of a Series of Cases, Bull. Ayer Clin. Lab. Penn. Hosp., 1: 4, 1903.

Infiltration of the skin with hyperplastic lymphadenoid tissue occurs most frequently in the affections commonly designated lymphatic leukemia, mycosis fungoides and lymphosarcoma, less often in myelogenous leukemia, Hodgkin's disease, and rarely in other members of the lymphoblastoma group.

LEUKEMIA CUTIS

Two major kinds of skin lesions occur in leukemia. One group is composed of those lesions which are microscopically true leukemic infiltrations, and the other comprises nonspecific cutaneous manifestations which histologically show nothing characteristic of leukemia.

Specific Eruptions.—The first group, or true leukemic infiltrations of the skin, appears most often as discrete nodules or tumors, but at times as a widespread symmetrical and diffuse swelling and infiltration, with erythrodermia. The *nodular variety* (lymphadenosis cutis circumscripta) begins as one or more discrete bluish-red or plum-colored painless cutaneous nodules of a doughy consistency, or as subcutaneous nodular infiltrations covered by apparently normal skin. The most frequent location is on the face, but they may occur on other parts, especially the extensor surfaces of the extremities and on the breasts, being, however, more common in the latter location in the myelogenous variety. The lesions may be rounded tumors or flat-topped raised plaques, usually covered with stretched but otherwise normal epidermis, which, however, at times is papillomatous. The nodules tend to grow to the size of a hen's egg and then to remain stationary or to involute, without ulceration or scarring. Although these lesions have been reported in myelogenous leukemia, they are far more frequent in the lymphatic type of the disease.

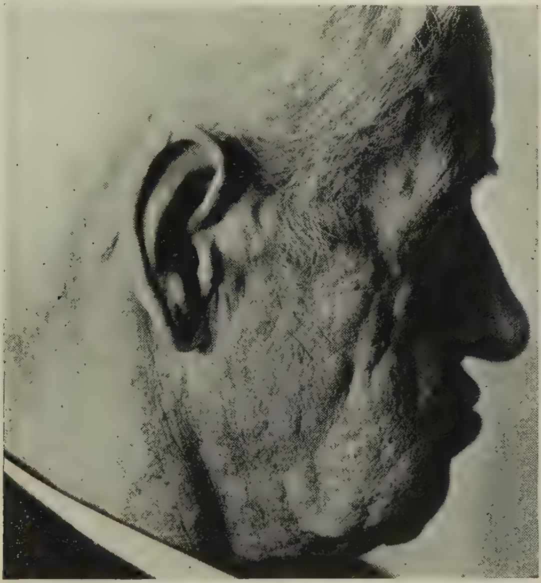

Fig. 901.—Leukemia cutis. Nodular subcutaneous infiltrations on the face.

Diffuse infiltrative lymphadenomatous erythrodermia (*lymphadenosis cutis universalis*) is manifest by a general and symmetrical swelling and redness of the skin associated with severe pruritus. The surface skin may be simply stretched and smooth, slightly scaly, severely exfoliative, eczematized or lichenified. There is an enlargement of all palpable lymph glands in the lymphatic type and of the spleen in the myelogenous type, and there may be shedding of the hair and nails. Clinically the differentiation from granuloma fungoides and pityriasis rubra may be a difficult task. A positive diagnosis is made in the laboratory.

Nonspecific Eruptions.—The nonspecific eruptions which occur in leukemia are polymorphous and of a toxic nature. Itching alone or with eruptions is a common feature. Urticarial, bullous, and erythema multiforme-like manifestations are common, and papulonecrotic, eczematous, and zosteriform changes are observed, and rarely even diffuse erythrodermia, hemorrhagic exanthems, and ulcerations.

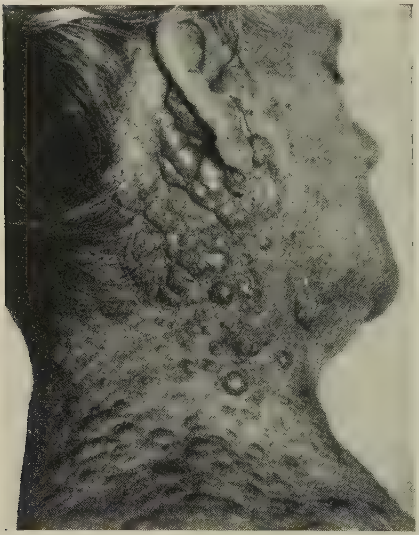

Fig. 902.—Myelogenous leukemia. (Courtesy of Drs. Lloyd W. Ketron and Leslie N. Gay.)

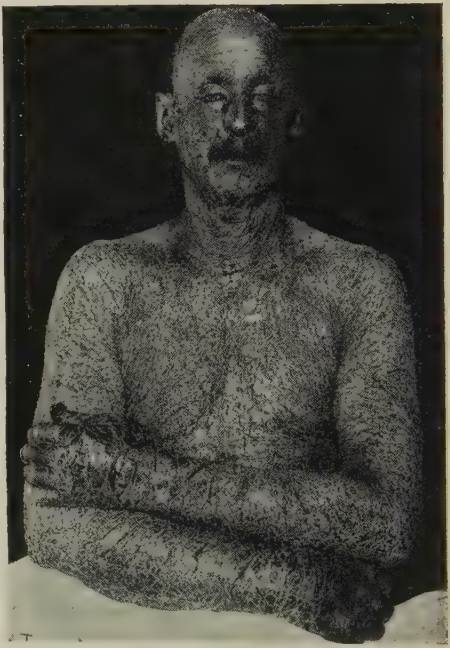

Fig. 903.—Universal lymphatic leukemia, showing marked exfoliation with much infiltration of the entire cutaneous surface. (Courtesy of Drs. Lloyd W. Ketron and Leslie N. Gay.)

Allied Disorders.—In chloroma greenish tumors may occur which resemble sarcoma, being sometimes accompanied by a blood picture simulating acute myelogenous leukemia or, in other instances, lymphatic leukemia.[1]

In polycythemia Gans reports a deeply infiltrative skin lesion composed chiefly of cells corresponding morphologically to small lymphocytes which gave a positive oxydase reaction, so that they probably belong to the myelogenous group.

HODGKIN'S DISEASE

Synonym.—Lymphogranulomatosis cutis.

In Hodgkin's disease the skin lesions are also both specific and nonspecific. The former may be circumscribed infiltrations, but more commonly are papules. These come out in crops on the extremities or on the trunk and run an indolent course, during which some may have urticarial characteristics or undergo central necrosis, so that they resemble prurigo, scabies, or papulonecrotic tuberculide. The lesions are accompanied by itching, which is augmented at the time of each outbreak. The skin is also usually pigmented, being dappled with brownish spots, and may become eczematized. The nonspecific eruptions are presumably of a toxic nature, and may be erythematous, urticarial, vesicular or bullous, frequently resembling erythema multiforme.

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[1] Gans, O.: The Skin Picture in Hematopoietic Diseases, Arch. Dermat. and Syph., 16: 4, July, 1927.

The skin manifestations may precede or accompany the characteristic

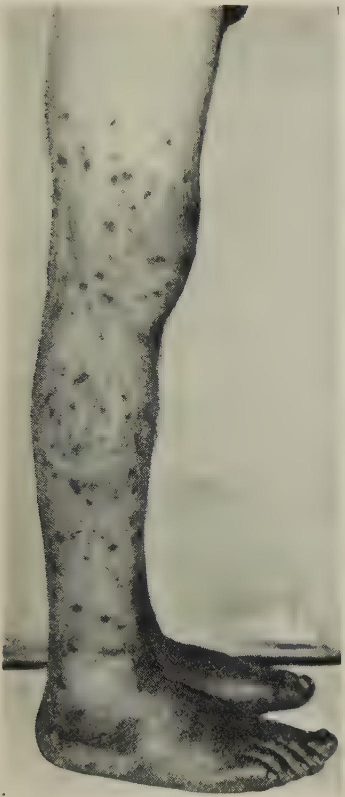

Fig. 904.—Hodgkin's disease. Papulonecrotic lesions upon the legs, resembling a tuberculide.

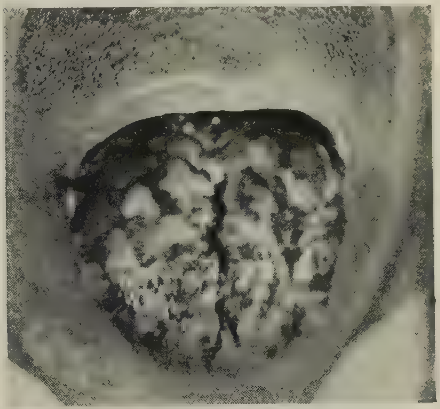

Fig. 905.—Exfoliative glossitis in Hodgkin's disease. A similar condition was present on the glans penis.

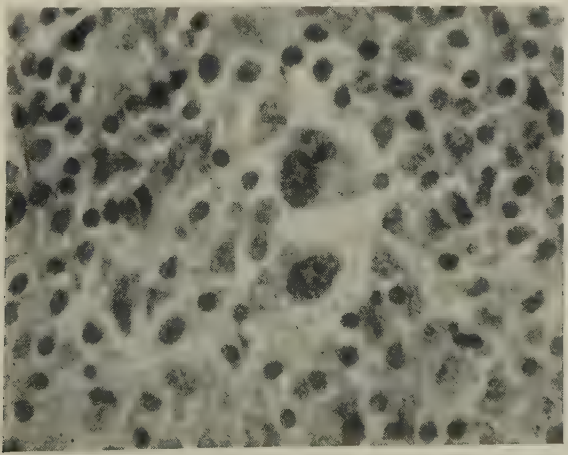

Fig. 906.—Hodgkin's disease. Reed-Sternberg cells in lymph node. (Courtesy of Dr. J. Gardner Hopkins.)

enlargement of the lymphatic glands, and may also sometimes be an important and early diagnostic feature.

LYMPHOSARCOMA

Lymphosarcoma of the skin results only from metastases from other organs, which may appear early or late in the course of the disease. Clinically the lesions are usually multiple papules or subcutaneous nodules of various sizes. They may regress spontaneously or they may result from treatment by arsenic or radiation.

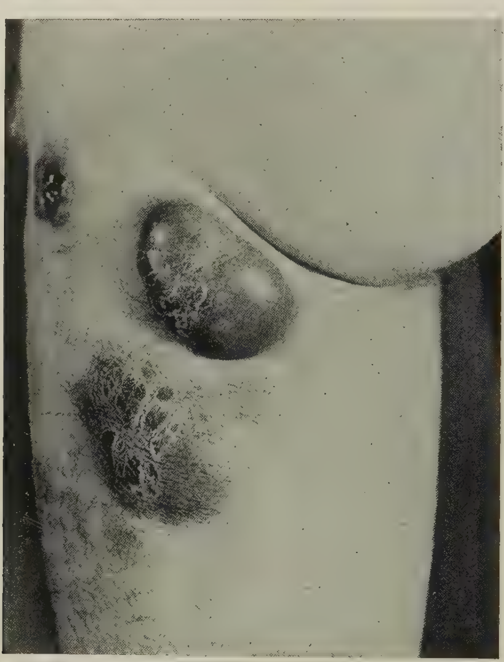

Fig. 907.—Lymphosarcoma. Plum-colored tumors in the skin of the thigh. (Courtesy of Dr. Lawrence K. McCafferty.)

MYCOSIS FUNGOIDES

Synonyms.—Granuloma fungoides, lymphodermia perniciosa, fibroma fungoides, multiple sarcoma of the skin, eczema tuberculatum.

Mycosis fungoides is a rare, chronic, and usually fatal disease of the skin, which runs a progressive course in which there are remissions. The course may generally be divided into four stages: (1) General pruritus; (2) nondescript erythematous, eczematous, or psoriasiform eruptions; (3) infiltrated plaques, and (4) tumors; but it may begin with any one of these manifestations, and exist without the others. Except in the type which begins with tumors (d'emblée type) the onset is insidious and does not suggest the gravity of the process, so that the true nature is not recognized for some time.

Course.—The *first stage* has received little attention, but may be present several years before the onset of any eruption. The etiology and seriousness of protracted pruritus are frequently difficult to determine, but no case of generalized persistent itching can be regarded lightly until the cause is fully explained. I had one patient who had been treated for several years for pruritus cutaneus and who later developed infiltrated plaques and tumors, and died of mycosis fungoides.

The *second stage* is sometimes called the premycotic or prefungoid stage, but these terms have not much meaning. Cutaneous eruptions simulating various forms of dermatitis, such as eczema, psoriasis, seborrheic dermatitis, erythema multiforme, and pityriasis rubra may occur, being formed by macules, papules, urticarial lesions, bullae, or scaly patches. The eruptions may show no distinctive clinical features, may be transitory or persist for a long time, or they may possess from the beginning or develop suggestive characteristics such as configuration, polymorphism, or vivid coloration. These qualities are worthy of more detailed consideration. The configuration is liable to take unusual forms such as cruller-shaped rings, rounded patches, curled ribbons of varying width, semicircles, large wavy or lobulated crescents, band-like angular projections, and other bizarre patterns. Sometimes a single lesion heralds the outbreak of the premycotic eruption by several weeks. The eruptions may be composed of a multiformity of lesions. There are commonly macules and large flat-topped papules that fuse and spread to form extensive well-defined patches with more or less exudation and scaling. The lesions are of unusual colors, vivid shades of red predominating—scarlet, salmon, rose, and crimson. A bluish tinge may be present when the circulation is sluggish.

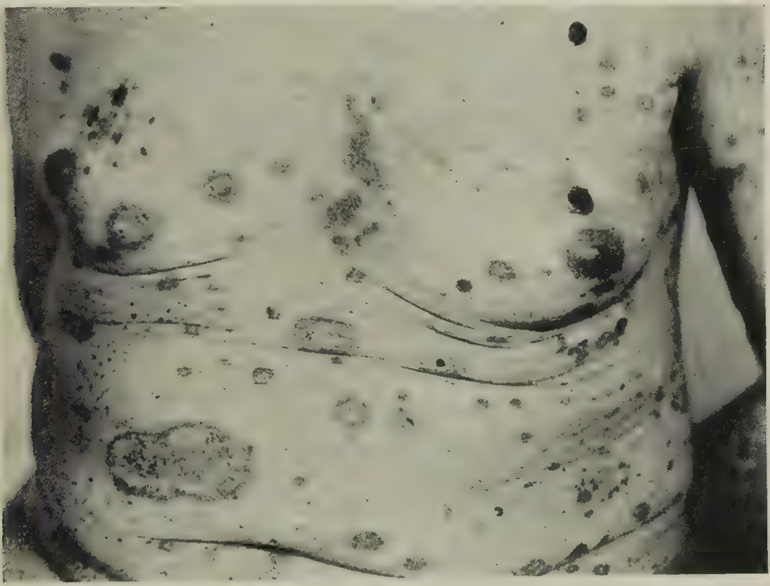

Fig. 908.—Mycosis fungoides, showing typical plaques.

The *infiltrated stage*, occasionally also called prefungoid, is characterized by the development of infiltration in the existing and new patches, the mucous membranes, as well as the skin, being subject to involvement. The infiltration at first is recognized by light palpation and may be present in only a few of the lesions. It is a manifestation of diagnostic importance, because its presence immediately classifies the disease as other than a simple inflammatory process. The infiltration becomes more and more marked and leads to discoid patches or extensive plaques, which may be several inches in width. These are apt to be sluggish or acutely inflamed and on the face may simulate leprosy or erysipelas. Eventually through coalescence of various plaques the involvement becomes widespread ("homme rouge"), but there are always some spots of apparently normal skin interspersed. When there is such advanced involvement superficial ulcerations occur and lead to agonizing pain. The hair becomes scanty, the nails dry, and ridged; the spleen and lymphatic glands are likely to be enlarged. Death may take place during this period, but more commonly, due to augmentation of the infiltration, the disease progresses into the *tumor stage.*

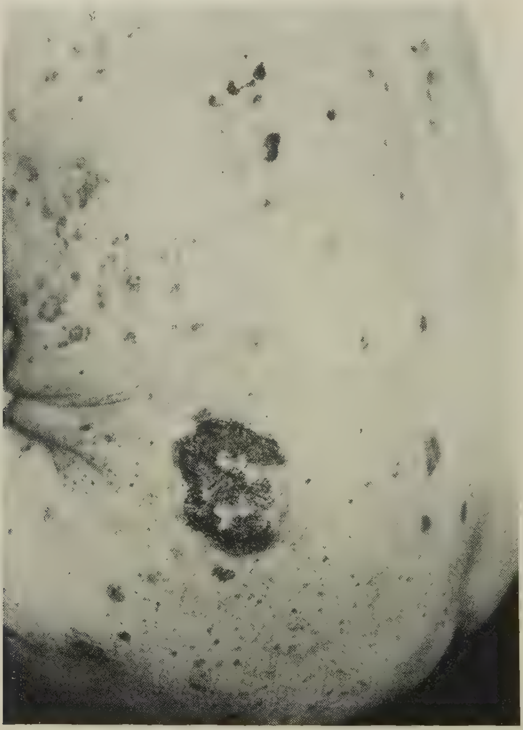

Fig. 909.—Mycosis fungoides, showing characteristic configurate ulceration and a common distribution of the lesions.

The tumors usually develop on infiltrated patches, but may be observed on apparently healthy skin, and are of various sizes and shapes. They have a tendency to break down early and to form deep oval ulcers, with bases covered with a necrotic grayish substance and with edges that are sometimes definitely rolled. The lesions are generally multiple and have a predilection for the trunk, although they may be seen anywhere on the skin or may involve the mucous membranes of the mouth and upper respiratory tract. The course of the disease during the tumor stage may be grave or mild. Death, as a rule, ensues from exhaustion, septicemia, or intercurrent bronchopneumonia in a few months or years after the beginning of the tumor stage.

Etiology.—The cause of mycoses fungoides is unknown. The disease has been ascribed to both inflammatory and neoplastic processes. Fraser believes that there is a genetic relationship between mycosis fungoides, lymphatic leukemia, and lymphosarcoma and that it has its origin in the reticulo-endothelial system of the skin. Numerous micro-organisms have been isolated from areas affected by the disease, but probably they were only contaminants. Inoculations of tumor tissue into animals have yielded nothing definite. The disease occurs only in adults and mostly in males.

Diagnosis.—Clinical diagnosis is difficult or impossible in the early stages. The early distinctive features of the skin manifestations—configuration, polymorphism, coloration, and infiltration—have already been discussed. When these are insufficient to warrant a definite conclusion, assistance is often afforded by histologic study even in the early stages. There is a peculiar cellular infiltration, also characterized by polymorphism. The infiltration and the nature of the pathologic process have been described in the chapter on Pathology.

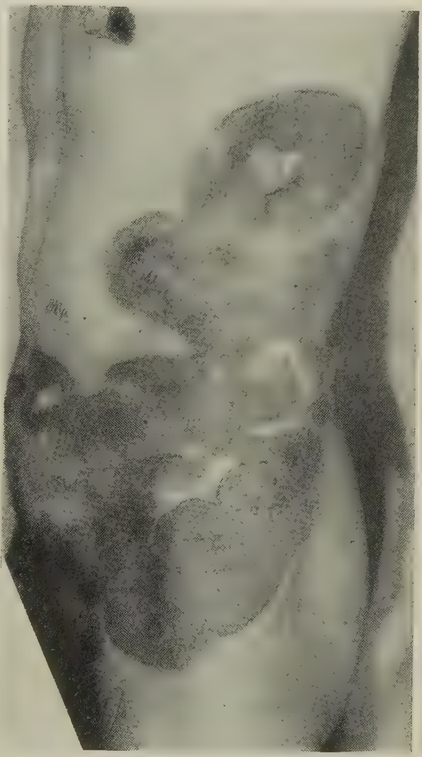

Fig. 910.—Large infiltrated eczematoid plaques. Mycosis fungoides. (Courtesy of Drs. Lloyd W. Ketron and Leslie N. Gay.)

Prognosis.—The outcome is always serious, but some cases may be arrested for an indefinite period, or others may even seem to have been cured. Whitfield reported a case of a patient with mycosis fungoides in which his clinical diagnosis was confirmed by microscopical examination by both Dr. Colcott Fox and himself. After the disease had been cleared up by *x*-ray treatment, the patient lived without a relapse for a great number of years, finally dying of apoplexy when more than seventy years of age. "It appears therefore that it is justifiable to take great risks in the endeavor to cure patients of a disease which is otherwise invariably fatal, and in its terminal stages is accompanied by hideous suffering." Cannon has a patient under his care who was previously treated by Fordyce. The patient has been free from the disease for nine years. In many instances life is prolonged for ten to twenty years by radiotherapy. This treatment allays the intolerable itching and makes the infiltrated areas of skin soft and supple, and causes the large mycosis tumors to involute. Unfortunately the improvement is only for a time and the lesions recur, but by persistent radiotherapy suffering is alleviated and the distress caused by large ulcerated tumors is avoided. On the other hand, improper *x*-ray treatment may cause serious systemic disturbance from rapid absorption from involuting lesions or may augment an aplastic anemia which sometimes occurs in the disease.

Treatment.—*Roentgen therapy* is the most effective of the various methodt of treatment. It gives astounding relief even in subfractional exposures, bus as it is continued its effectiveness is gradually diminished until it is of little value. In rare instances, as stated, apparently the disease has been permanently arrested by its use. The schedule for treatment, however, should be largely symptomatic, and the dosage should be continuously watched because of the possible occurrence of toxemia resulting from over-irradiation.

There are two outstanding methods. One is the treatment of the affected area, usually with unfiltered *x*-rays. The other method is to treat the disease as a systemic disorder resembling leukemia, heavily filtered radiation being used upon all parts with total disregard of the local manifestations. The former is advisable for mild cases and those in which *x*-rays have not been extensively used. The latter is of paramount value in patients who have reached the point where the first method does not suffice. These pitiable, weak, tormented and apparently moribund patients will receive renewed strength and comparative comfort for many months by the systemic use of *x*-ray therapy.

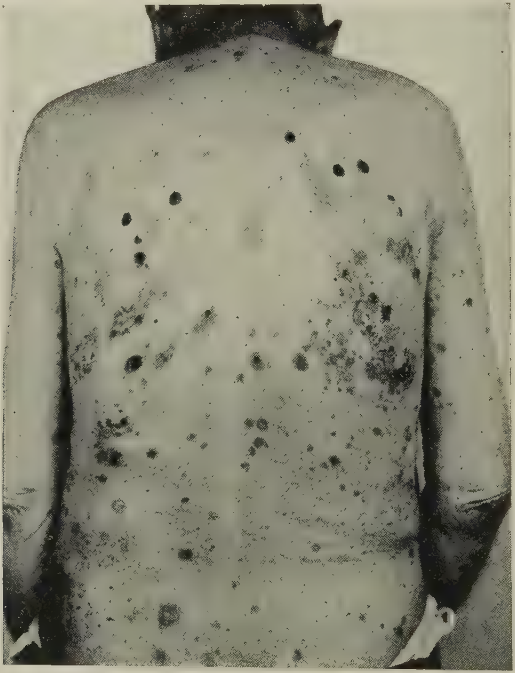

Fig. 911.—Mycosis fungoides beginning tumor stage.

The dosage for *local therapy* depends upon the stage of the eruption and the amount of previous irradiation. In erythematous, urticarial or eczematous types the treatment should begin with $\frac{1}{8}$ or $\frac{1}{4}$ E. D., unfiltered, to the affected areas. Not more than six or eight areas should be treated in one day until the patient's tolerance is known, as nausea and malaise due to absorption of toxic products from the local involution may follow more extensive irradiation. After the patient's tolerance has been established, the dosage is regulated by the character of the lesions. Upon isolated patches 1 E. D., unfiltered, at intervals of three weeks may be employed. Indurated plaques should be treated with a similar dose or suberythema fractional exposures. The tumor stage requires increased dosage, usually 2 to 3 E. D., unfiltered, or 2 E. D. filtered. During these large exposures the skin about the lesions is shielded by lead. In some patients, as irradiation continues and becomes gradually less effective, the dosage may be increased without producing excessive effects. It is desirable to test the tolerance of the patient's skin occasionally during the course of treatment to determine the erythema exposure, as in extensively irradiated cases the toleration seems to be enhanced. For test areas the delicate skin of the inner surfaces of the thighs is best.

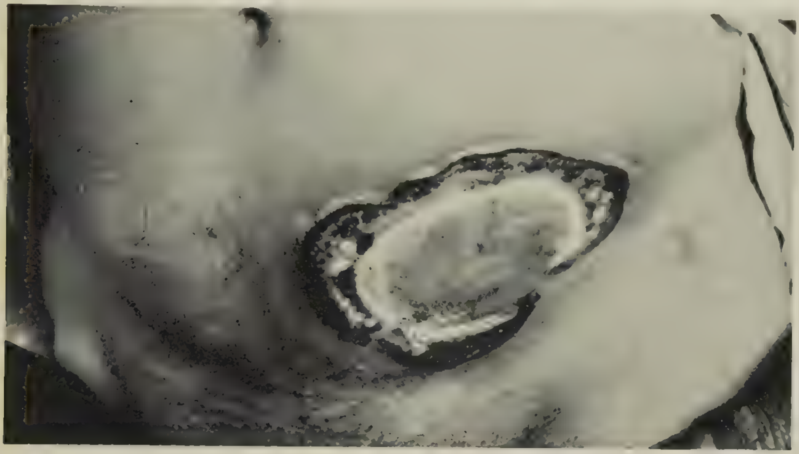

Fig. 912.

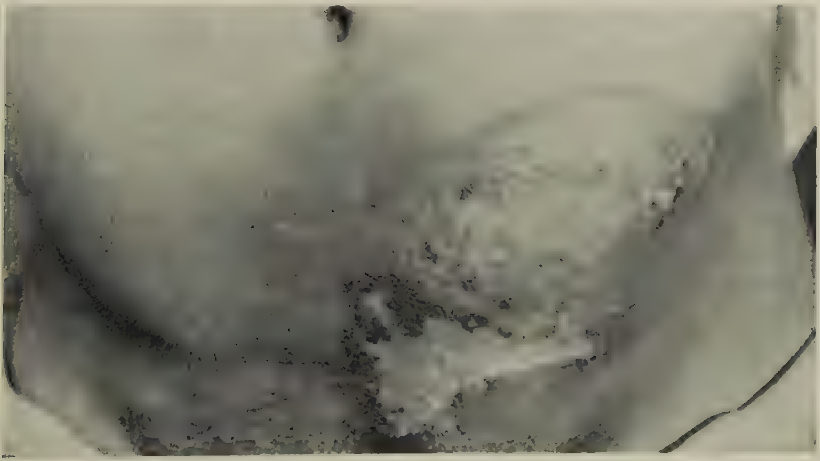

Fig. 913.

Figs. 912, 913.—Mycosis fungoides, d'emblée type. Before and after two exposures of filtered x-rays.

In one patient who had received several courses of intensive therapy, nearly 2 E. D. were required to produce an erythema on an area 1 inch square on the inner aspect of the thighs. The blood examination of this patient at the time showed only 70 per cent hemoglobin, which might account for the diminished skin reaction. Areas which have been previously irradiated or are heavily pigmented do not offer favorable sites for testing.

In severe cases which have ceased to respond to local therapy, *filtered* *generalized irradiation* is used. The skin surface is divided into approximately sixty areas to which one third of an erythema exposure is applied at ten-day intervals. About ten areas are treated daily for six successive days, after which there is a rest interval of four days, and then a blood count is taken. In the course of a month a full erythema filtered exposure has been given to all parts of the patient. If symptoms are not alleviated by this time, a fourth generalized treatment of one third of an erythema exposure may be given, but irradiation thereafter should be stopped for an interval of six weeks.

Usually the benefits from such therapy are pronounced and give relief for at least a few months. Before the institution of such a course of treatment, a diagram of the body areas should be made, each area numbered and a chart prepared, showing those to be treated on certain days, the rest intervals, and dates of blood counts. This scheme of treatment must then be strictly followed.

Supplementary to *x*-ray treatment, *certain other measures* are helpful. The pruritus is often relieved by high colonic irrigations containing sodium bicarbonate. Arsenous acid by mouth or hypodermic injections of sodium arsenite (see page 464), or intravenous injections of arsphenamine should be used, as the effects of large doses are often excellent. Nonspecific protein therapy has been of some value. Intercurrent infections, such as erysipelas, may cause temporary improvement, due to a nonspecific protein action. Radium water by mouth and a solution of radium emanation intravenously hold out possibilities. The former is generally too weak and expensive to be of much value and the latter is exceedingly dangerous in its present stage of technic. Stevens injected solutions of radium chloride (50 to 75 micrograms) intravenously into a patient suffering from mycosis fungoides with marked benefit.

Local remedies give little relief. Ointments containing ammoniated mercury, 5 per cent; oil of cade, 5 per cent; zinc oxide, 20 per cent; ichthyol, 20 per cent, or butesin picrate, 1 per cent, are employed but have doubtful value. To overcome the fetid odor which is present in the late stages, baths containing potassium permanganate, ʒj, or solution of aluminum acetate, Oj, or wet dressings of these drugs; or lotions containing phenol, boric acid, or bichloride of mercury are used.

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CHAPTER XXXII

DISEASES OF THE SKIN APPENDAGES

AFFECTIONS OF THE HAIR

Before the reader can understand *aberrant forms of hair growth,* a knowledge of the normal structure and development of hair is essential. These points are covered more fully in special works,[1] but the available information is scanty on the normal duration of life for individual hairs, the periods of follicular activity and quiescence, and some other apparently simple phases. The growth of hair is primarily determined by the inherent character of the hair follicles, which potentially differ as to race, individuals, and location on the body. Many aberrant manifestations at times have hereditary tendencies, and again seem to be of sporadic occurrence. Aberrant forms of growth may be classified as excessive, deficient, and abnormal. Some instances which fall in the last category are of known parasitic cause and have been taken up elsewhere (page 551) and others are rare conditions of the capillus which require only brief mention.

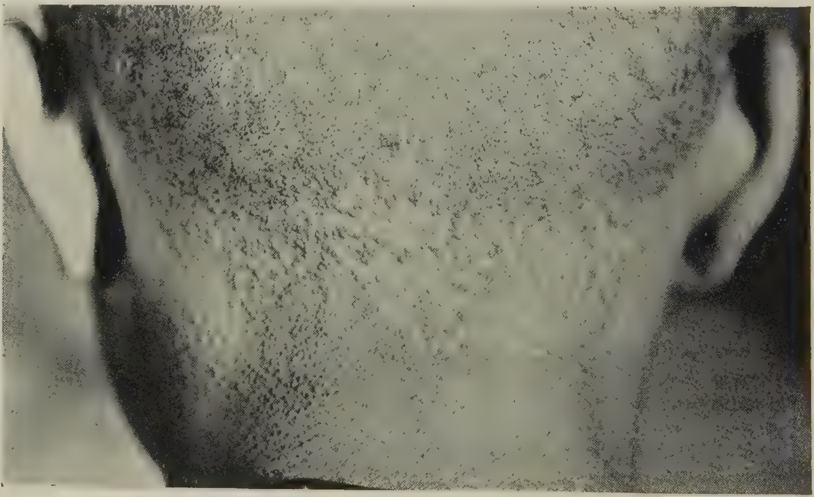

Fig. 914.—Monilethrix. Note sparse short hair and follicular keratosis of the back of the neck.

Monilethrix (*beaded hair, moniliform hair*) is an unusual congenital and hereditary affection characterized by dryness, fragility, and sparseness of the scalp hair, with fusiform or spindle-shaped swellings of the hair shaft separated by narrowed atrophic segments. The hair tends to break off at the delicate internodes. The disease is often associated with keratosis pilaris of the extensor surfaces, temples, and back of the neck. Hair on other regions than the scalp may be affected.

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[1] Danforth, C. H.: Hair, Chicago, Am. Med. Assn., 1925. Hubbard, S. D.: A Treatise on Diseases of the Hair and Scalp, Phila., Lea & Febiger, 1928.

Treatment is of little benefit. Roentgen therapy has been recommended by some. My experience is limited to one case, treated by the usual epilation technic employed for tinea tonsurans. The hair which regrew was just as severely affected as that before treatment. Ointments containing sulphur, oil of birch, and salicylic acid massaged into the scalp may give slight improvement. Gilchrist reported a case which recovered spontaneously.

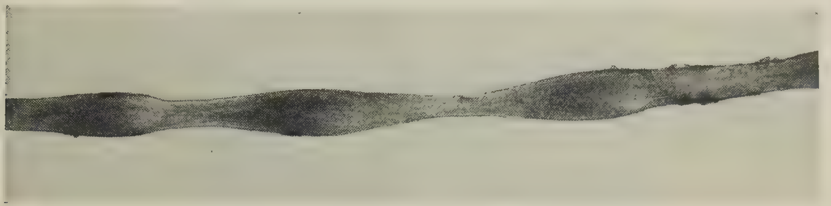

Fig. 915.—Monilethrix, hair showing alternating constrictions and fusiform enlargements.

Trichonodosis (*knotted hairs*) is an apparent or actual knotting of the hair, probably resulting from an inability of new hairs to grow freely from their follicles, due to an increased toughness of the surrounding tissues. **Trichorrhexis nodosa** (*fragilitas crinium*) is characterized by what seem to be white spots on the hairs at more or less regular intervals. These are places where the hair cortex has fractured and split into strands giving a microscopical appearance which suggests pairs of brooms stuck together end to end by their bristles. The hairs break at these nodes. **Ringed hair** is a peculiar affection in which the hair has the appearance of being banded by alternate segments of light and dark color when seen in reflected light. The light areas have been shown to contain a gas, possibly air.[1] Its mode of entry into the hair is unknown. The three conditions—trichorrhexis, monilethrix, and ringed hair—give evidence of varied follicular activity occurring in cycles of about the same length, and are believed by Danforth to be largely influenced by the vege-

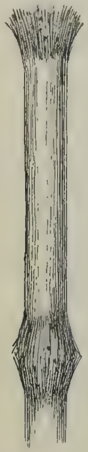

Fig. 916.—Trichorrhexis nodosa. (Stelwagon.)

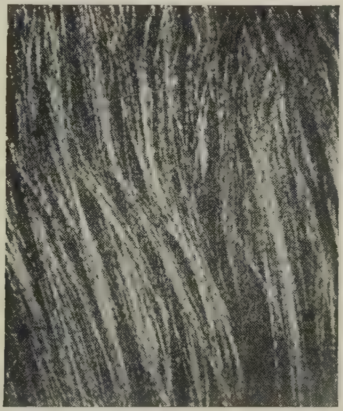

Fig. 917.—Ringed hair. (Courtesy of Drs. Lee D. Cady and Mildred Trotter.)

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[1] Cady, L. D., and Trotter, M.: A Study of Ringed Hair, Arch. Dermat. and Syph., 6: 301–317, Sept., 1922.

tative nervous system. **Graying of the hair** (*canities*) although very common is an unexplained phenomenon.

Trichomycosis axillaris is a nodular condition of the hair of the axillary and genital regions due to fungi. Castellani has described various clinical types of this disease, which has been previously known under the term "leptothrix." A yellow variety is common in all climates and the etiologic agent is a minute fungus (Nocardia tenuis), which is present in great numbers.

On the shaft of the affected hair there are discerned, microscopically with the low power objective, roundish formations at several places which partially or totally encircle the shaft. Under high power, these are seen to consist of mycelial hyphae embodied in an amorphous cementing substance. In the red and black varieties, in addition to masses of mycelial segments of N. tenuis, there are large groups of coccus-like bodies (M. nigrescens in the black variety and M. castellanii in the red variety). The diagnosis is easily made, being based upon the presence of yellow, red or black nodules on the hairs of the axillae or pubes, sometimes associated with hyperidrosis or an erythematous condition or yellowish discoloration of the skin of the axillae. The treatment recommended by Castellani is the use of sulphur ointment at bedtime and sponging the hairs with a 2 per cent solution of formalin in alcohol.

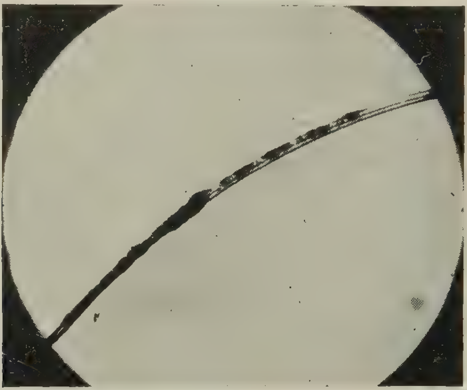

Fig. 918.—Trichomycosis axillaris, hair showing nodular condition as seen with low power objective. (Courtesy of Sir Aldo Castellani.)

"In the discussion of the complicated problem of hair deficiency, attempted refinements of terminology are rather ahead of actual knowledge of conditions. . . . **Alopecia** in its various forms may be congenital or it may be acquired at any time subsequent to birth. Depending upon the circumstances, it may be either transient or permanent. Anything which destroys the follicles or inhibits their function becomes an etiologic factor."[1] The cause may be heredity, senility, severe sickness, nervousness, local disease of the hair follicles—seborrheic dermatitis, ringworm, favus, *et cetera*—traumatism, or physical and chemical agents—subjects discussed elsewhere. Some of these causes may act indirectly through the endocrine glands. Whatever the ultimate cause of baldness of the head so common in men, Osborn regards it as a definitely hereditary sex-limited trait, dominant in the male, recessive in the female. Danforth believes "Baldness, like many other conditions, is probably hereditary in some and not so in others. It seems probable, however, that it is most often hereditary, particularly when without obvious pathologic involvements it appears before the thirtieth year. An observation on eunuchs,[1] if correct, suggests that the factor for baldness may ordinarily be effective only in the presence of the testis."

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[1] Danforth, C. H.: Hair, p. 108.

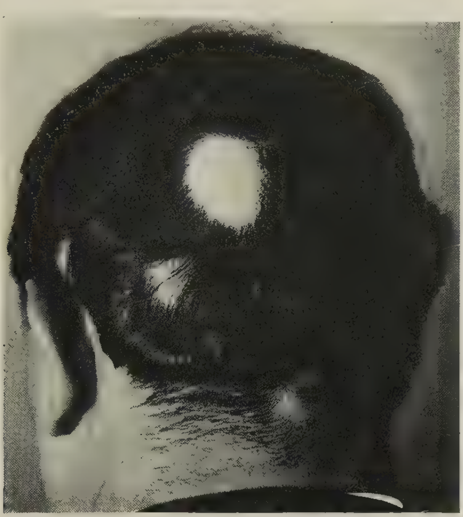

Fig. 919.—Alopecia areata.

Alopecia areata (*alopecia circumscripta, area Celsi, tinea decalvans, porrigo decalvans, pelade*) is characterized by rapid and complete loss of hair in patches. It usually affects the scalp, but may involve the beard, eyebrows, eyelashes, or even be universal. Generally when first noticed, the

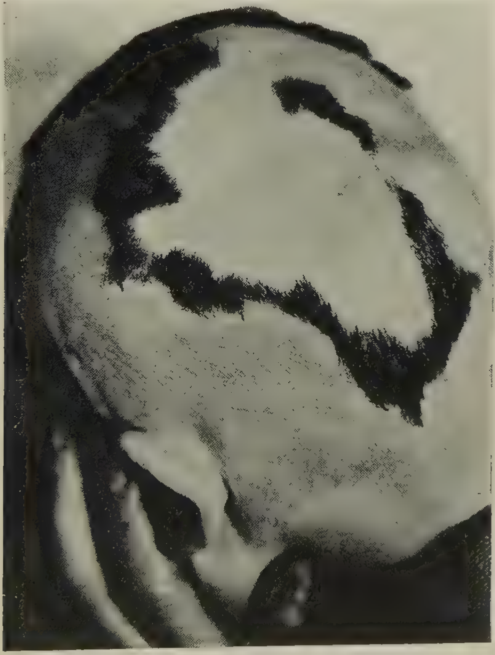

Fig. 920.—Alopecia areata.

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[1] Sabouraud, R.: Maladies du Cuir Chevelu, Paris, Masson et Cie, 1902.

patch is round, bald, smooth and glossy, although at the periphery there are some loose hairs. These may be broken off near the scalp, leaving short stumps. When they are pulled out it is often possible to see an attenuation of the bulb due to atrophy of that portion, which has given rise to the term "exclamation point hairs." Gradually these fall and new hairs are observed growing at the center of the patch. At first they are downy and light in color, but later are replaced by stronger hairs, which in the beginning lack pigment, but usually soon become the same color and texture as the normal hair. Although the tendency is for spontaneous recovery, the repair process may stop at any stage, leaving the areas permanently bald, or sparsely covered, the color of the hair light or white; or there may be successive weak short-lived growths. In other cases the development of new patches may be so rapid that the entire scalp is soon bald. Universal alopecia may develop suddenly or be superimposed gradually upon alopecia areata. The universal type of the disease generally affects middle-aged persons, although it may appear at any age.

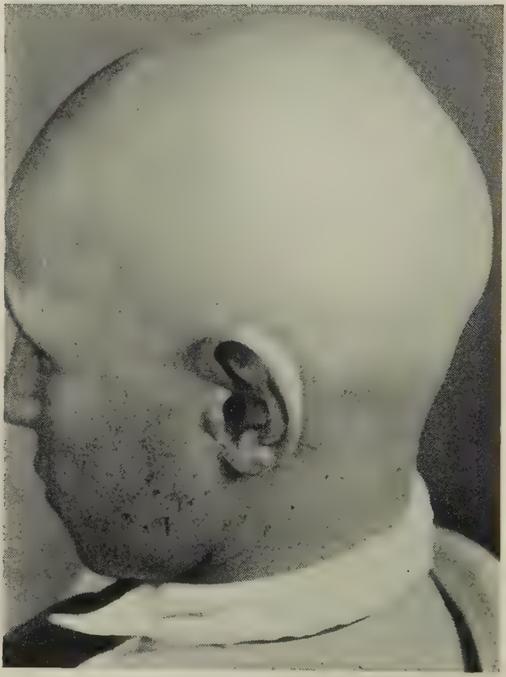

Fig. 921.—Alopecia totalis.

The etiology of alopecia areata is unknown. Focal infections, endocrine disturbances, and diseases of the nervous system are often spoken of as predisposing causes. A similar condition is produced by the ingestion of thallium, which suggests possibly a toxic cause. The relation of the disease to tinea tonsurans and other bacterial infections of the scalp is also a conjecture.

Alopecia cicatrisata (*alopecia circumscripta, alopecia orbicularis, pseudopelade of Brocq*) is a rare form of baldness in which a destruction of the hair follicles produces multiple round, oval, or irregularly shaped, hairless, cicatricial patches. The bald areas may be small or large, and may be scattered or grouped. They are usually coin sized, and white or slightly pinkish in color, with a smooth, shiny, atrophic surface, which is sometimes dotted, especially toward the periphery, by small epidermic follicular plugs. At times there is a lardaceous appearance of the patch, partly due to the absence of the follicles, or a pinkish halo about the periphery. No pustules, crusts, or broken-off hairs are present. The onset is as a rule insidious, with one or two patches on the vertex. The alopecia is permanent and the affection is slowly progressive. In advanced cases large plaques may be formed by coalescence of some of the many small patches. Although the cause is unknown, a trophoneurosis seems probable.

Treatment, from the standpoint ot restoration of the hair, is futile, but attempts should be made to arrest the progress of the disease by the ultraviolet rays and other suitable remedies.

In addition to the foregoing abnormalities and deficiencies in hair growth and those due to pathogenic organisms or specific trophic disturbances, there are others which are obviously hereditary and often congenital. The degree of alopecia in these cases shows wide variations, and some are also associated with absence of the lanugo hairs and sweat glands, and with dental aplasia or malformations of the nails (see page 865).

Treatment.—Many generally accepted concepts about hair production and replacement lack any reliable susbtantiation. It is commonly believed that some medicinal external applications influence hair growth through their effect upon the hair itself, although it is doubtful if any external stimuli have even slight direct effect upon the growth. The weight of evidence proves that any hair promoting qualities of external applications are due to indirect action through the skin. When external stimuli cause changes in the perifollicular vascularity or reactions in the sympathetic nervous control of the cutaneous structures associated with the hair follicle, an indirect action upon hair growth may take place. Stimulation of the cutaneous circulation and of the nerve supply of the follicle is undoubtedly the most important action of hair tonic.

Although the effect of the endocrine glands upon hair growth is still obscure, they have a recognized relationship to it. The thyroid, gonads, suprarenals, and the pituitary are of major importance, there being without doubt a close relationship between the glands of internal secretion and the sympathetic system. However, there are few proved facts in regard to the influence of the glands of internal secretion on the sympathetic system and the hair. It is well known that disturbances in the growth and character of the hair occur in certain diseases of the ductless glands, but the exact mechanism by which the changes are produced is not known. The hair changes in pregnancy and at puberty are also dependent on the endocrine glands. In cases of alopecia after childbirth or severe sickness or in those with signs of myxedema, thyroid and ovarian glandular therapy is so beneficial that it should not be neglected. In addition, the state of the general health, eye strain and nerve strain are undoubtedly important factors in some instances.

Sunlight, ultraviolet light, and roentgen rays have been credited with direct stimulating effects upon hair growth. These claims have not been corroborated by reliable evidence. In some instances the erythema produced by the exposure may account for the benefits obtained, although the effect of hyperemia upon hair growth is also a matter of conjecture. However, the beneficial influence of ultraviolet rays on baldness has been demonstrated beyond a doubt. If the atrophic process in the hair follicles has not progressed to a hopeless stage, the increase of blood supply, and rarely perhaps the improved quality of the blood following ultraviolet therapy, will usually stimulate the growth of hair more reliably, quickly, and safely than any other remedy. The treatment should be instituted in the early stages of the disease when atrophy of the follicles is not extensive.

The best results are obtained by local exposures which produce an intense erythema, and the more intense it is and the more often it is produced, the greater is the benefit. The ultraviolet hyperemia probably possesses no special characteristics to distinguish it from hyperemias caused by heat, chemicals, massage, and other means, but it may safely be many times greater than can be produced by these other agents, and instead of damaging the skin, the application is usually beneficial.

The scalp is prepared for treatment by shaving or clipping the hair closely and removing the greasiness by ether on gauze. When dry, the scalp is massaged or manipulated for ten minutes and then given an intensive dose focused respectively on the vertex, frontal and parietal regions, and the occiput. The exposure is repeated after the reaction subsides, treatments usually being given at weekly intervals over a period of three to four months. Smaller doses of ultraviolet light will stimulate hair growth in many instances, but are less effectual.

In addition to local treatment, general light baths for tonic effects are often advisable. They are specially indicated in those cases of alopecia associated with constitutional derangements—alopecia symptomatica.

Stimulating external applications generally contain mercury, sulphur, resorcin, carbolic acid, salicylic acid, capsicum, cantharides, colocynth, or tar. These may be prescribed according to the pharmaceutical suggestions given (Eczema chapter, pages 414 to 416). In addition the following combinations are useful:

℞.	Oleoresin of capsicum	ʒij
	Alcohol	℥v
	Water	℥viij

M. and filter clear. Add castor oil ʒss and oil of violet gtt. v. Sig. Scalp stimulant. Apply with massage daily.

℞.	Liquor. carbonis detergent.	
	Resorcin	āā ʒij
	Hydrarg. chlor. corrosiv.	gr. iv
	Alcohol, 50 per cent	q.s. ad. ℥viij

M. and S. Shake and apply daily with massage.

The plan of treatment for baldness follows that given for seborrheic dermatitis of the scalp (page 413), viz., a lotion for daily use, a pomade or oil to be applied once or twice weekly the night before shampoo, and a shampoo soap. Oily scalps are shampooed once or twice weekly and dry scalps once or twice monthly. The treatment is chiefly local, although ill health naturally influences the scalp affections unfavorably. In alopecia areata and alopecia symptomatic of some constitutional condition, special attention should be given to general measures.

Hypertrichosis.—*Synonyms.*—Hirsuties, superfluous hair, hypertrichiasis, polytrichia.

Hypertrichosis occurs in a number of forms and is due to a variety of causes. Extensive hypertrichosis present at birth or appearing early in childhood, and the localized excessive growth of hair in nevi are in a totally different category from the moderate forms of facial hypertrichosis in women. The most common type in women is upon the upper lip only and, in contrast to some extreme forms is, according to Trotter and Danforth, a definite hereditary dominant trait, which shows a correlation of 0.8 between mothers and daughters. The frequency of hypertrichosis in Jewish women has often been noted, and it seems more common in brunettes. Another type which is frequent in women of all ages, but apparently occurs more often in those past middle life is characterized by a more or less developed moustache and a growth of hair on the sides of the chin. This is called the negroid type, since a similar distribution is frequently seen in negro men. "This type of hypertrichosis is supposed popularly to develop at the menopause, but Trotter was entirely unable to substantiate this view. Instead she found evidence that the average length and the average diameter of facial hairs in women increase steadily from youth to old age with no conspicuous change at any particular period. The fact that the condition is noticed in many young women, while many old women do not have this hypertrichosis, as well as the fact that it cannot be produced by removal of the ovaries, counts against the idea that hypertrichosis in elderly women is due to the cessation of ovarian function. It seems far more probable that the excess hair that may appear on the faces of older women is comparable to that which appears on the ears, in the eyebrows and in other regions of men as they grow older."[1] A type which is more rare is that in which most of the bearded region is affected, with a growth similar to the masculine beard. All grades are seen from the mild to the severe. Whereas some of the latter group of occurrences seem to be related to premature sexual development, the physical normality of many women who have had beards that were more developed than those of the average man, has been clearly established.

In other words, facial hypertrichosis of the rather common forms observed in white women seems to be preeminently a matter of constitution, and, in any event, subjects with the mild type of hypertrichosis and many of those with a more pronounced form cannot properly be considered as abnormal, because it has never been shown that they have any other constant physical or psychic peculiarity which differentiates them from women with less hair. The etiology of hypertrichosis shows that it is often hereditary, sometimes of endocrine origin, and rarely from local inflammatory conditions, which may be from the use of cosmetics. McEwen has stated: "The glands which have been proved experimentally to be related to the pilary system are the thyroid, hypophysis, the suprarenals, and the gonads," but the literature contains in addition many references to the pineal, thymus, and parathyroids. The cases due to local irritations and other extraneous causes probably represent only a small fraction of those who have hypertrichosis.

Internal *treatment*, including organotherapy, is useless. Experiments are being conducted with thallium acetate given orally, and this remedy may sometime be valuable as an adjunct to roentgen therapy. At present both must be used in quantities too large for safety.

For those who have a tendency to develop superfluous hair, proper instruction in the *care of the skin* is helpful. Such skins are often oily, and there is frequently an associated oiliness of the scalp. The treatment of seborrhea of these regions should be instituted, and proper directions given for cleans-

[1] Danforth, C. H.: Hair, pp. 130–131.

ing (Acne, page 500). The liberal use of powdered almond meal, powdered pumice, or artificial pumice-stone block not only cleanses thoroughly but also acts as an abrasive on the hairs. There is some reason to believe that the removal of hairs by abrasives makes the growth less vigorous.[1]

For temporary removal *epilating waxes*, usually made of beeswax and rosin, are satisfactory in many cases of cosmetically objectionable hair. The careful experiments of Trotter seem to indicate that the temporary removal of hairs, no matter what the method, has no effect in stimulating their growth. Indeed, I have been told by reliable, observant women who have used these waxes for years, that without doubt they gradually cause a decrease in the number of hairs. Pusey has stated: "The mechanical removal causes some traumatism of the hair follicle which must be followed by slight inflammatory reaction. It is possible that the prolonged repetition of this inflammatory reaction might, in time, produce sufficient sclerosis around the follicles to cause shrinking of them. Certainly, I see no reason to believe that there is any objection to the temporary epilation of superfluous hairs.

". . . A wax which is efficient for epilation, and which is in every way as satisfactory as commercial waxes, can be made of beeswax, one part by weight, and finely powdered rosin, four parts by weight. The wax is melted over a low fire and, after melting is complete, the powdered rosin is poured in. The heat is continued and the mass stirred gently until entirely melted; this requires from one to two minutes.

"For use it then needs to be molded. It is the consistency of home-made candy and can be handled in the same way. One way is to pour it into a deep dish and then crisscross it with deep markings about ¾ inch apart as though one were making caramels. The plate must be greased, say, with petrolatum, to prevent the wax sticking to it. After it is cooled the wax is fairly brittle and the blocks can be broken off for use. It can also readily be molded in sticks by taking heavy paper and making a hollow tube about ⅝ inch in diameter and 3 inches long, one end of which is closed off by being folded in. After the melted mixture has been poured, the tube is allowed to stand until the mass hardens. This takes only a few minutes. Heavy wax paper is the best for this purpose, but any wrapping paper can be used, provided it is greased on the inside to prevent sticking. Wax, 2 drams (7.5 cc.) and rosin, 1 ounce (30 Gm.) make a workable stick; about two or three times as much should be used for making square blocks.

"The method of removing hairs with the wax is as follows: A block, or the end of the stick, is melted by heating over a flame until it becomes soft; this can be done with a temperature that will not burn the skin. When softened, the melted wax is rubbed on the skin in the direction of the hair growth. It is well to press it down with the moistened end of the thumb, until one gets a layer about ⅛ inch thick. This is allowed to cool, or is chilled by the application of ice or cool water. After it is cooled, the edge of the wax is picked up with the nail and the wax pulled off with a quick pull in the opposite direction to the growth of the hairs. This is only slightly uncomfortable. If the application has been well made—and it is easy to learn to do this—few hairs will remain on the surface. Those that do remain had best be left for subsequent application, or removal with epilating forceps. The fragments of wax that stick to the skin can be picked off or easily dissolved with carbon tetrachloride."

Nobl has given the following similar prescription: Tincture of iodine, 3 parts; turpentine, 6 parts; castor oil, 8 parts; spiritus collodii to 80 parts. The region must be painted over thickly with the mixture. It dries quickly and the painting is repeated. The edge is seized, and the whole film, with all the hairs embedded in it, is torn away. Another satisfactory formula is the following:

℞.	Rosin	50	Gm.
	White wax	10	"
	Venice turpentine	0.3	"

Melt all over a slow fire and allow to cool. When dry and hard, break up into small crystals. To apply, cover area with thick coat of talcum powder. Warm just enough crystals to spread over surface (do not have hot enough to burn skin), spread over area, allow to cool and harden, then raise corner and pull off with a quick rip.

Depilatories containing barium sulphide corrode the projecting hair shaft, but have no destructive action on the intrafollicular growing portion. They are liable to irritate the skin and are on the whole unsatisfactory.

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[1] Schwenter-Trachsler: Eine neue Methode zur Beseitigung des Frauenbartes, Arch. f. Dermat. u. Syph., 111: 69–75, 1912.

℞.	Barii sulphidi (gray, fresh)	ʒij
	Amyli pulv.	ʒiij
	Zinci oxidi	ʒiij
	Ol. pini sylvest	gtt. xv

℞.	Calcii sulphidi	1 part
	Water (to make paste)	
	Zinci oxidi	3 parts

(As the above may be irritating the ingredients should be on the label with a word of caution.)

Mix into a paste with a little water, rub on the skin for five minutes, scrape off softened hair with edge of tablespoon, wash the skin and apply the soothing lotion.

Shaving is a common form of temporary relief and of these measures is second only to the epilatory waxes. Opposed to popular belief, there is no evidence that shaving increases the coarseness or amount of the hair and there is strong evidence to the contrary.

Bleaching with hydrogen peroxide or equal parts of it and a strong water of ammonia makes dark hairs less noticeable and corrodes the finer hairs. Before it is applied, the skin is cleansed with ether to remove any oiliness. It is advisable to begin with one tenth of the usual strength.

For permanent removal the only safe method is *electrolysis*. Epilation by electrolysis involves the killing of the active part of the follicle and bulb by inserting a needle beside the shaft and passing through it a current that will accomplish this result with the least possible injury to the surrounding tissues. This treatment should be done only by a specially trained physician who understands the physiology and anatomy of the skin and who is also versed in electrical modalities. Excellent vision, together with good coordination and a steady hand, is necessary, and the operation should be performed in a proper light, with both patient and operator in comfortable positions. Experience has shown that better work is done in the morning than later in the day, and that treatments of more than one hour's duration are too fatiguing. Although the speed of operation is of some importance, it is secondary to accuracy and the use of a small amount of current.

Electrolysis is based on the polarity action of the constant (galvanic) current. The negative pole is the active electrode, while the positive pole is the indifferent electrode. A fine bulbous pointed platinum needle is connected to the negative pole (cathode) of a source of galvanic current, either a few dry cells connected into a battery, or the commercial "direct" current passing through a suitable resistance (rheostat), or the "alternating" current changed into a direct one by a motor converter. A gauze or sponge covered "indifferent" electrode, held by the patient, is connected to the positive pole (anode)—the alliteration of *p* to *p*, and *n* to *n*, may be noted. This should never be reversed for if it is, the current will cause a charring of the skin. The needle is inserted from 1/16 to 3/16 inch into the hair follicle, the current being turned on. Usually a current of 1 ma., flowing for not more than forty seconds, will produce sufficient caustic sodium hydroxide around the needle to destroy the lining of the hair follicle; at the same time hydrogen is liberated, which appears at the mouth of the follicle with a slight crackling noise as small bubbles in white foamy fluid. The hair so treated will offer no resistance when removed with the tweezer. In many cases ½ ma. of current is sufficient, and occasionally where there are bristly hairs 1¼ ma. may be employed. For work on the upper lip a current of only $\frac{1}{4}$ ma. is sometimes advisable, because scarring is more apt to occur there than in other areas. For this reason, the removal of hair from the upper lip requires unusual care and should be left until the last and then treated with a smaller current than that used upon the rest of the face. The individual hairs treated on any one day should be $\frac{1}{2}$ cm. distant from each other, so that the electrical effects will not be superimposed and lead to scarring.

The results obtained from electrolysis depend mostly upon the skill with which the needle is inserted directly into the hair follicle. Pressure should not be used. The experienced operator simply slides the needle, without resistance, into the follicular lumen. Attempts should not be made to treat short stubby hairs less than $\frac{1}{4}$ inch in length, for it is impossible to judge correctly the slant of follicles containing such short hairs. The patient should let the hairs grow to a proper length before the treatment, for the longer the hairs, the easier is the manipulation. Electrolysis is occasionally impracticable when the hair is silky in texture and profuse. The individual hairs may be almost invisible but so numerous that they are disfiguring when seen collectively. These conditions are best treated by the use of depilatory wax. Where the hairs have been tweezed by the patient or where they have been pulled out by wax depilatories, electrolysis is occasionally difficult, due to the roots being irregularly curved. It is likewise important to use a needle holder, which will permit the needle to be placed at any angle. When such a holder is used the hand may rest on the patient's face to prevent tremor of the fingers.

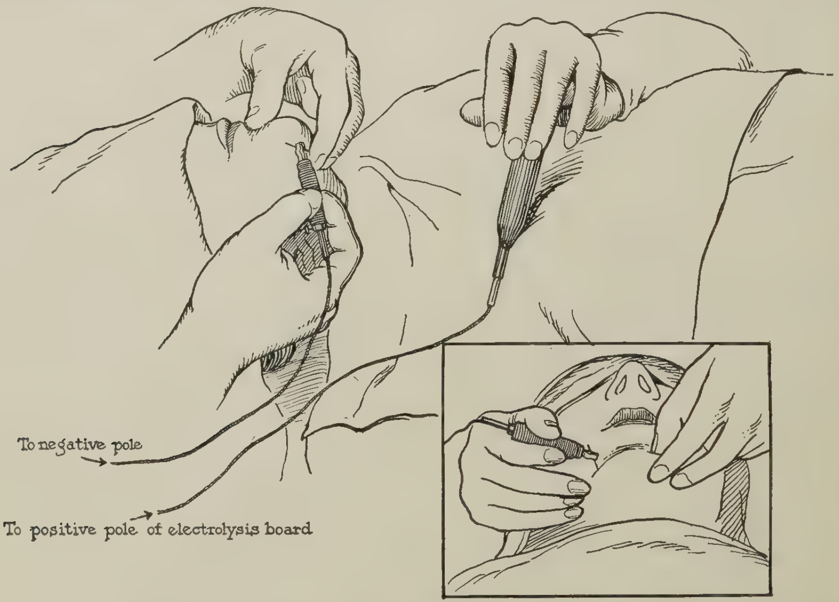
To negative pole
To positive pole of electrolysis board

Fig. 922.—Illustration of the technic of electrolysis. Note that the patient is recumbent, that the operator puts the skin on the stretch by the fingers of his left hand, and that he gives his right hand poise by placing the fourth and fifth fingers against the side of the patient's neck; also, that the needle holder is balanced lightly on the right index finger.

If the needle does not enter the hair follicle, it meets with resistance resulting in the blanching of the skin around it, accompanied by considerable pain. In the course of a minute or two, sufficient local edema is produced to cause a loosening of the hair so it may readily be pulled out, but as the follicular cells have not been destroyed, regrowth is immediate. Multiple needles are used by some unreliable operators for the sake of rapidity, but they are condemned because of their inaccuracy, which favors recurrences and scars. As has been stated, if the needle is properly inserted, a white foam exudes, due to the liberation of hydrogen within the follicle. When this has occurred and while the needle is still in place, the hair is removed with the slightest traction. When noticeable traction is necessary, it signifies that the hair bulb is not completely destroyed, in which case the operator should return to it shortly and by the slightest traction the hair will be removed, for the electrolytic action evidently continues for a few minutes after the needle has been withdrawn. Following the operation, the face should be dabbed with calamine and zinc lotion containing 2 per cent phenol.

A short time after the hair has been removed from the follicle, a tiny brown punctum appears and this soon changes into a minute vesicle, which later forms a crust. In some patients the current produces a wheal. These skin reactions vary according to the individual and the amount of current, as well as the refinement of the technic. As a general rule, the skin of brunettes requires more time for healing than the skin of blondes, perhaps because the former tends to pigment or stain from slight traumatism.

A certain number of recurrences—10 to 15 per cent—is inevitable even under expert treatment. Such hairs must be removed a second time, but their number is small enough to be unimportant. Counting the time required for the treatment of all recurrences, one should generally estimate from one to eight hours' work for the type of facial hypertrichosis involving the upper lip only, five to twenty hours' for the negroid type, and twenty-five to one hundred and fifty hours' work for the masculine beard type.

Scarring is the only danger of epilation by electrolysis. For this reason, patients should be advised against picking off crusts or scabs, or mechanically forcing them off by too vigorous cleansing. The hairs in any location should not be removed too closely, otherwise the area will become edematous and indurated, and when the induration has subsided, scarring may remain. Scarring, however, is usually the result of imperfect technic—most often the use of multiple needles, or excessive milliamperage, or the failure of the operator to insert the needle exactly into the follicle.

The biterminal current of surgical *diathermy* is also used for epilation. The instrument and technic are the same as with electrolysis, only the patient is connected with a high frequency current instead of a galvanic current. This method is more rapid than ordinary electrolysis. A specially fine, pointed needle is connected with one terminal, and an indifferent electrode is attached to the other and applied to the skin of the forearm. The needle is inserted along the hair shaft into the follicle to a depth of 3 to 4 mm., and the current is turned on with a footswitch, after the machine has been set to give the smallest possible spark. A current of about 60 ma. applied for one to two seconds is sufficient to destroy the papilla. Excessive current produces a white halo in the skin about the needle. The hair is removed with a trivial amount of traction. This is followed by slight redness of the area and a tiny inflammatory papule, which disappears in two to three days, leaving no mark. In thirty minutes it is possible to treat about 150 hairs. More experience with this method is necessary to determine whether the speed does not entail lack of accuracy, and therefore more scarring than is derived from the slower removal by the galvanic current.

Attempts to cure hypertrichosis by *x-rays* are about as old as the *x*-rays themselves, but little technical advance has been made since the pioneer work, and the foremost feature of over thirty years of experimentation is the danger which prohibits their successful application in this affection. One sees an occasional good result, but the vast number of patients so treated sooner or later develop telangiectases, wrinkling, dryness, and scarring of the skin. Not infrequently the injuries are more severe, producing sclerodermatous thickening, superficial ulceration, or changes predisposing to cancer. It is impossible to insure against undesirable sequelae, and it is universally agreed among dermatologists that such dangers out-balance the benefits.

It is a fairly difficult matter to cause temporary falling out of facial hair by the use of *x*-rays without provoking an erythema, but in the treatment of hypertrichosis this temporary epilation does not suffice. In addition, the hair follicles must be damaged so that they will not produce a regrowth. Their radiosensitivity is slightly greater than that of the other structures in the skin, and upon this very slight difference in susceptibility to *x*-rays the entire treatment is founded. To remove hair permanently the amount of radiation required is such that it will cause permanent skin injuries of an undesirable and more or less hazardous character in about 90 per cent of the patients. A few patients (10 per cent), by chance, seem to escape damage, due to the fact that irradiation is stopped before the treatment is finished, so that the removal is incomplete; or because the sequelae have not had time to develop; or, more rarely, because the sequelae are not manifest although the interval usually required for their appearance has elapsed.

Hypertrichosis is a cosmetic defect the cure of which does not warrant additional disfigurement and the risk of a dangerous disease. It has been urged that some cases are not amenable to electrolysis when the hair is silky, downy and profuse, and that in such circumstances roentgen epilation should be approved. Such reasoning is erroneous because this type is likewise least radiosensitive and is incapable of successful epilation by *x*-rays. It has also been asserted that one might be permitted to epilate, by *x*-rays, patients severely afflicted whose livelihood is greatly handicapped by superfluous hair. This claim is equally unsound, for these poor creatures are least fitted for greater handicaps that inevitably follow the temporary relief given by *x*-rays. There is no age, no type of case, no ameliorating circumstance in which *x*-ray epilation of facial hypertrichosis is permissible.[1]

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[1] This improper and dangerous method of treatment is now being exploited on a large scale by advertising quacks.

"In New York there are several advertising institutions where scores of women are being gulled by false statements concerning the safety of this 'new' method of treatment. Some of the charlatans in charge of these institutions frankly admit that they use the roentgen ray. In fact, one of them said that he followed MacKee's text-book, though his technic was hopelessly crude. Others infer that they do not use the roentgen ray but some mysterious new 'wavelength' to accomplish their results. Their advertising circulars include partial and misleading quotations from recognized authorities.

"The disastrous results which would logically be expected are now beginning to make their appearance and unless a check is soon put upon this form of quackery the number of unfortunate victims will eventually be large. It is also quite probable that these bad results will lessen the confidence of the public in roentgenotherapy in general, even when practised by men of the highest skill and reputation." From Treatment of Hypertrichosis by the Roentgen Ray, editorial by Howard Fox, Am. J. Roentgenol., 14: 345, Oct., 1925.

Occasionally in hypertrichosis of the trunk and in the removal of hair from skin flaps in plastic surgery, x-ray epilation is warranted. Although these cases are rarely encountered and at best present a difficult problem, a rather full description of the technic will be given, because it is an expression of certain fundamental radiotherapeutic concepts which in themselves are instructive.

Filtration is favored by the majority of those who have had success in this field. Naturally the maximum biological effects occur in the strata of skin in which the greatest amount of x-ray energy is absorbed. With easily absorbable (unfiltered) x-rays, the greatest absorption is in the most superficial skin layers. As the hair papillae are situated at a depth ($\frac{1}{8}$ to $\frac{1}{4}$ inch) from the skin surface, unfiltered x-rays are absorbed mainly in the layers above them, there causing atrophic and vascular degenerative changes which are clinically evidenced by inelastic white paper-like skin and telangiectasia. This relative concentration of absorption of the beam of x-rays above the hair papillae can be tremendously reduced by filtration, which by cutting out the softer components increases the average penetration.

There are those who support the theory of a selective action of various parts of the x-ray spectrum on cells and those who claim the opposite, *i. e.*, that the biological effects of x-rays are identical, regardless of wavelength. In the latter conception, variations in the clinical effects depend largely upon the site of the concentration of the absorption of x-ray energy. To follow this theory to its logical conclusion, one would insert a thin filter to absorb the very soft rays (those which would not pass through the layer above the hair papillae), and leave those wavelengths which would be absorbed to a maximum at the level of the hair papillae. In practice this technic produces many sequelae and is generally condemned. The poor results may be caused by the fact that, at the level of the hair papillae and about them, the capillaries are most numerous and there is much white elastic tissue, which are highly radiosensitive elements whose destruction causes visible disfiguring sequelae.

The theory of selective action has been previously discussed, and the reader knows that specific affinities of different wavelengths for various cellular structures have proved a myth and are not, at the present state of our knowledge, supported by experiments upon plants, animals or patients. However, there is a general trend on the part of the clinicians to use hard radiation for attempted destruction of the abnormal tissue, without injury to the normal. Although Chamberlain and Newell discovered no differences in the epilation or erythema produced by equal doses in R units of hard and soft x-rays, their experiments were done on such small areas that their work is of no practical value. At least with short wavelengths, clinical effects can be produced which are impossible with long wavelengths, an example being the results in hypertrichosis. Here, with heavily filtered radiation, there is a little greater latitude between the amount required to produce an epilation and that which provokes an erythema, or causes telangiectasia, wrinkling, and other disfiguring sequelae.

Dosage is always fractional in all simple dermatoses where the subsequent appearance of the patient is taken into consideration, and, on the other hand, is intensive where dynamic action upon diseased tissue is desired regardless of the injury to normal tissue. x-Ray epilation of areas where the skin is delicate and where extreme care and technical refinement are necessary, is always by repeated suberythema doses, which by cumulative action produce permanent epilation. It is advisable first to administer a dose of x-rays which will cause a temporary defluvium without a skin reaction.[1] This having been done, the subsequent treatment is directed toward preventing a regrowth of hair. Meyer, who has reported the best results in modern literature, gives an epilating dose through 4 mm. aluminum filter, and repeats this after an interval of six to eight weeks, then gives a third exposure, when necessary, in not less than eight to ten weeks. He claims that in 50 per cent of the cases, after three treatments there is permanent epilation.

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[1] As a substitute for the initial epilating dose, some workers use a depilatory wax.

Occasionally a fourth exposure is given after an interval of ten weeks. The mucous membrances and the teeth of the upper and lower jaws are protected as much as possible by lead rubber. During treatment, razors, pincers, and depilatories are forbidden. Lukewarm oil is used for cleansing instead of soap and water. At each visit the skin is tested for vascular irritability and symptoms premonitory of radiodermatitis. Meyer has stated that some unfavorable reaction may occur a few hours after exposure—such as swelling of the mucous membranes or the parotid gland, dryness of the mouth, loss of appetite, or rheumatoid pains in the teeth—but that all symptoms are inconsequential and disappear in two to four days. He has observed no permanent injury from this technic.

Where the region to be epilated is a flat surface, it is much easier to estimate the distribution of the dosage than where the surface is convex or angular. With this fact in mind, it is advisable to divide any area to be epilated into parts which are approximately flat surfaces, and to treat each of these individually. The ill effects of slight irregularities in such areas may be minimized by increase of anode-skin distance. Epilation with roentgen rays is done with greater facility on the trunk than on the face, but in the axillae or on the extremities it is more difficult, as the treatment is complicated by the curvatures of these areas and in the axillae by the delicacy of the skin.

In the case of large, hairy nevi (see Hairy Nevi, page 851) epilation is sometimes desirable before removal by other means. The dosage must be considerably larger than when employed for other forms of epilation, especially when the mole is pigmented. Filtered erythema doses are necessary and permissible because the irradiated patch is to be removed after the hair follicles have been destroyed. Therefore, mild radiation sequelae, such as telangiectasis, are of no importance and the epilation can be done with one fairly large dose, usually $1\frac{1}{4}$ to $1\frac{1}{2}$ E. D. Similar results are afforded by the gamma rays of radium[1] (half-strength flat glazed salt applicator, screened with 2 mm. brass, in contact, for twelve hours).

At the suggestion of Muir, I have used removable platinum implants of *radon* in the treatment of hypertrichosis and thus far have found the method promising. Implants containing 3 mc. each are inserted to a depth of 1 cm. at equidistances of 2 cm. on the surface and left *in situ* for twenty-four hours. In the few cases I have treated thus far, this dosage has produced satisfactory epilation without erythema or cosmetic injury of the skin, but the method is still in the stage of experimentation. The technical details for the use of radon implants are described in the chapter on Radium Therapy.

A *combination of thallium* and *roentgen epilation* has been successful for temporary epilation of children who have tinea tonsurans. The usefulness of thallium in adults for the removal of hair is still to be proved and is accompanied by grave dangers. It is possible that at a later date the combined method will be advantageously applied to the treatment of hypertrichosis.

Medicolegal Aspects.—The implied contract of a physician is not to cure but to treat the patient with that degree of diligence and skill which is ordinarily possessed by the average members of the profession in good standing in similar localities.

To hold a physician answerable for not exercising more than ordinary professional skill is imposing upon him a heavier burden than the law has placed upon the professional man's shoulders. He is not an insurer of the patient's health or of recovery from an abnormal condition, but he is bound to exercise ordinary skill, such skill as physicians and surgeons in the general neighborhood, in the same general line of practice, ordinarily have to exercise in like cases. One who holds himself out as a specialist in the treatment of a certain organ, injury or disease is bound to bring to the aid of one so employing him that degree of skill and knowledge which is ordinarily possessed by those who devote special study and attention to that part, injury or disease, its diagnosis and its treatment, in the same general locality, having regard to the state of scientific knowledge at the time. Therefore, in the treatment of hypertrichosis of the face and neck by *x*-rays and radium, the physician is governed by the foregoing rules, and provided he exercises his best judgment and skill in the treatment of this condition, he cannot be liable in an action for malpractice, if sequelae from the treatment should develop.

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[1] *Radium* has been used by Simpson, Palumbo, Du Casse, Heidingsfeld and others for the treatment of facial hypertrichosis. The results have been, as one might expect, similar to those of x-rays.

It is important that the physician should fully explain to his patient the possible results and after-effects of roentgen and radium treatment for the removal of excessive hairy growth, and it is also to the advantage of the physician to procure a written statement, signed and verified by the patient that she has had the possible results of such treatment fully explained to her, and that the risks are to be assumed by her, thus releasing the physician from all liability.

While such verified, written statement and release would not be an absolute bar to an action, yet it would prevent the possibility of perjury in case an action for malpractice was thereafter brought by the patient against the physician, because, as stated above, the physician can be held liable only if the plaintiff is able to prove negligence on his part.

DISEASES OF THE FOLLICLES

Folliculitis may arise from many causes—bacteria, fungi, or chemical irritants—or may be due to involvement by eczema and other dermatoses. Treatment is influenced by the etiology. Infections of the follicles by the staphylococcus have already been discussed (page 514), as also have those by the tubercle bacillus (page 618), and fungi (page 569). Folliculitis may be produced by chemicals ingested and excreted through the sweat, or by those rubbed upon the skin through external contacts. The treatment of the former condition is discussed under dermatitis medicamentosa, and the latter under dermatoses due to chemical irritants. The treatment of other forms of folliculitis and perifolliculitis is described under appropriate captions.

All deep follicular infections may lead to epilation, as, for example, favus, furunculosis, syphilis—diseases of known etiology. There are, however, other follicular diseases of unknown causes which by gradual and deep extension produce scarring and loss of hair. This group comprises a variety of clinical conditions which are all characterized by insidious onset, slow progression, and recalcitrance to treatment. To these cicatrizing alopecias, many names have been given.

Folliculitis decalvans is a common variety in which small pustules about the follicles, erythema, scaling, and hairless, smooth, shiny, depressed scars are apparent. Early cases resemble sycosis vulgaris of the scalp, but in advanced cases only the margins of the white scarred patches show any pustules or other signs of active inflammation. Hemolytic staphylococci are often found upon culture and vaccines made from them are of therapeutic value.

Roentgen-ray treatment is frequently successful. A few fractional, unfiltered exposures may be curative, or it may be necessary to cause a temporary defluvium of the hair. In mild cases ultraviolet radiation is beneficial. All of these procedures should be accompanied by the local application of drugs, such as sulphur, mercury or iodine, and by frequent shampooing.

Perifolliculitis capitis abscedens et suffodiens is a rare suppurating and cicatrizing disease of the scalp, characterized by the occurrence of many indolent fluctuating abscesses, comedones, and scars. The entire surface of the scalp may be involved but the occiput is the site of predilection. There may be solid nodules present, but most of the lesions are fluctuant and contain a seropurulent or granular fluid, from which the cultures are sterile. Sinuses and crusts appear. The primary lesions are apparently large comedones about which the abscesses develop as a reaction of the tissues against foreign bodies. Histologically, there is a granuloma, containing numerous foreign-body giant cells.

Treatment is unsatisfactory, surgical methods being preferred. The comedones should be removed and the abscesses incised and drained. It is often possible to pass a probe through burrows that connect several abscesses; these should be freely exposed. Wet dressings of potassium permanganate solution, 1 : 5000, or zinc chloride solution, 1 : 1000, are recommended.

Keratosis follicularis contagiosa, an apparently infectious disease, which resembles keratosis follicularis, occurs in children. The eruption is widespread and symmetrical, affecting chiefly the back of the neck, the shoulders, and the extensor surfaces of the extremities. There is a horny thickening of these areas, especially pronounced about the follicles, where small black corneous plugs may be discerned. The skin is dry and rough. Keratosis follicularis contagiosa is differentiated from Darier's disease by its incidence principally in children, histologically by the absence of corps ronds, and by the fact that greasy scaling which is encountered in Darier's disease is never present in this infectious disorder. Sutton states that the disease responds readily to treatment; Brooke used an ointment containing iodide of mercury successfully in his cases.

Keratosis pilaris has been considered on page 861 under Nevus. Some eruptions are possibly not of congenital origin, but are caused by local follicular irritation from dirt and improper hygiene.

Lichen spinulosus (*keratosis follicularis spinulosa, lichen pilaris seu spinulosus*) is a disease chiefly of children and is characterized by minute filiform spines which protrude from the follicles, being discrete but grouped. The cause is unknown, but from the histology it seems to be a toxic, productive inflammatory process. The lesions are readily eradicated by mild keratolytics, such as 3 per cent resorcin or salicylic acid ointment.

DISEASES OF THE SWEAT GLANDS

Disorders of the sweat glands from external cause are infrequent. The coil gland is well protected against easy access of organisms owing to the anatomical nature of its entrance and its comparatively long narrow canal. This being continually washed by a centrifugal stream affords effective resistance to the ingress of organisms.

Hyperidrosis (*idrosis, hidrosis, ephidrosis, sudatoria, polydrosis, sudorrhea,* or *excessive sweating*) may be of local or general distribution and may result from various reflex nervous, toxic, or circulatory causes—organic or functional disturbances of the nervous system, dysfunctioning of the glands of internal secretion, obesity, sluggish circulation, and toxicity—which should be investigated and treated.

In localized hyperidrosis, especially of the axillae, palms or soles, the most effective method of treatment is with *x*-rays. In other locations, such as the scalp or cheeks, the amount of radiation necessary to inhibit the activity of the sweat glands permanently would cause other atrophic and destructive changes—alopecia or wrinkling—which prohibit its use. Fortunately, the worst cases of hyperidrosis affect the axillae, palms and feet, where adequate doses may be safely applied without the production of undesirable sequelae. The skin of the axillae is delicate and radiosensitive, and temporary epilation or hyperpigmentation of these regions is not objectionable; the palms and feet, where the skin is tougher on account of the thick epidermis, will tolerate the necessary dosage without any difficulty. The soles will tolerate a little more than the palms, and the latter, a little more than the axillae.

The technic for irradiating these areas has been described in Chapter VI, on page 125.

The margin is not great between the dose which inhibits the functions of the sweat glands or causes permanent atrophic changes in them and the dose which produces an erythema, atrophy, or telangiectasia. For this reason, extreme care is necessary in the roentgen-ray treatment of hyperidrosis. There are two steps in the procedure: first, the attainment of temporary inhibition; secondly, the transition of the temporary into a permanent effect.

The attainment of temporary inhibition, as evidenced by the first decrease in the amount of sweating, is accomplished with fractional doses of x-rays, filtered through 3 mm. aluminum, $\frac{2}{3}$ E. D. being given at intervals of three weeks. The change is noticed first by the patient and is quite definite, usually occurring after the third or fourth treatment, but rarely after a single exposure.

Definite inhibition having been once obtained, the transition into permanent relief is an easy procedure, in which experience helps considerably, as the guides to dosage are clinical and vary according to the individual case.[1] The average requirement may be expressed as $\frac{1}{2}$ E. D. given by the same technic once monthly for three months.

After the treatments are stopped the sweat secretion will continue to diminish for a few weeks and as a result the skin is likely to become, temporarily, too dry. A few weeks later some regeneration occurs, and the secretion becomes of normal amount. Permanent excessive dryness is to be studiously avoided. It is almost as objectionable as hyperidrosis, being uncomfortable and predisposing to cracks in the skin, and once the sudoriferous and sebaceous glands are destroyed, there is no relief for it except the use of oils and greases. Irradiation should therefore be discontinued before the sweating is completely arrested.

The diet should be bland (see Rosacea, page 510), and exercise should be moderate. Tonic baths containing sea salt or alum are at times useful. Local applications of 5 per cent zinc or aluminum chloride in 50 per cent alcohol, or 3 per cent formalin solution are effective, and especially desirable when the sweat is offensive. When dry, the lotions should be followed by a dusting powder containing 3 per cent aluminum chloride, 3 per cent salicylic acid, and 10 per cent powdered alum.

Bromidrosis (*osmidrosis* or *malodorous sweating*) is chiefly encountered on the axillae, feet or about the genitals, being generally associated with hyperidrosis. In many cases it may be considered an apocrine[2] gland dysfunction, and possibly all instances will be thus explained, because there are marked differences in the distribution of these glands in man; and in other mammals with hair covering they may be found over the entire integument, being more numerous in the female sex.

The treatment of bromidrosis is similar to that of hyperidrosis, being, if anything, more satisfactory. Complete cures seem invariably to follow regular x-ray therapy. This may be combined with the local applications recommended for hyperidrosis, and frequent changing of the underclothes, dry cleaning of the outer clothes, changing of the stockings, the use of dusting powder in the shoes, and immersion of the parts in a bath of potassium permanganate solution, 1 : 5000, for twenty minutes a day.

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[1] See variations in skin toleration, Chapter VI.

[2] Schiefferdecker: Die Hautdrüsen des Menschen und der Säugetiere, ihre biologische und rassenanatomische Bedeutung, sowie die Muscularis sexualis, Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung, 1922. Schaffer, J.: Zur Einteilung der Hautdrüsen, Anat. Anz., 57: 353–372, 1924. Klaar, J.: Über die axillaren Knäueldrüsen der Affen, Ztschr. f. d. ges. Anat., 1 Abt., 72: 609–627, 1924.

Fox-Fordyce disease is a rare affection occurring mostly in middle-aged women and is characterized by small follicular brownish, intensely pruritic nodules in certain regions (the axillae, mammae, umbilicus, pubes, labia majora, and perineum). The hair in these areas is likely to be scanty, and from some of the nodules broken hair shafts may protrude and in the center of others there are empty follicular openings, which, when pressed, become filled with turbid secretion. The histology is an inflammation localized about the apocrine glands, which supports the theory that the disease is due to their dysfunction.

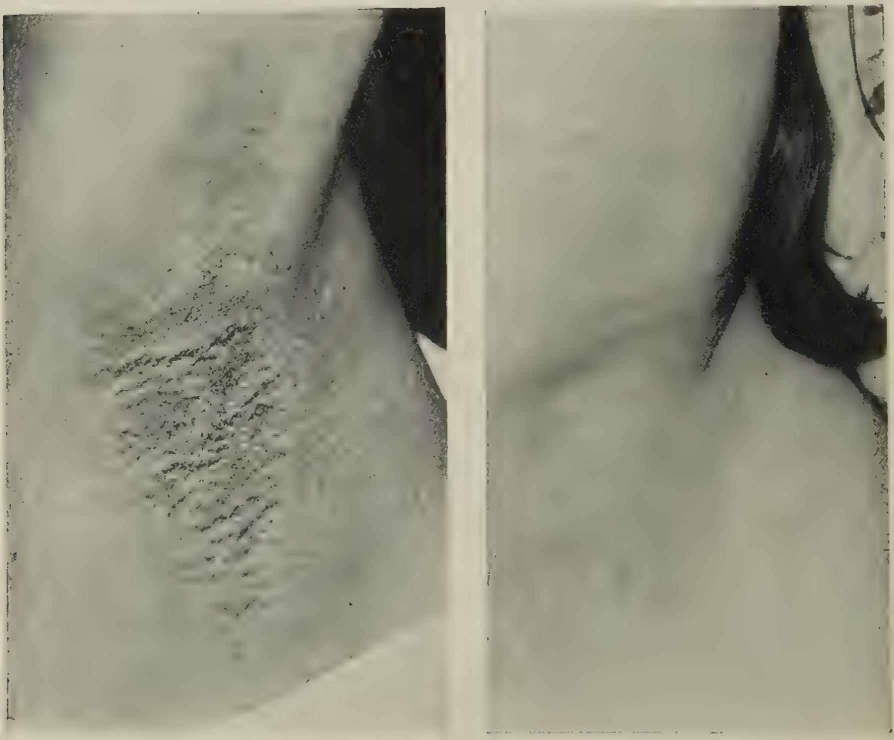

Fig. 923. Fig. 924.

Figs. 923, 924.—Fox-Fordyce disease of the right axilla. Before and after an epilating dose of filtered x-rays, which caused permanent regression of the disease.

As the pathogenesis seems to be a secretory disturbance related to the reproductive organs, Pick suggested organotherapy (consisting of the administration of ovarian and corpus luteum preparations), which was distinctly successful in two of his cases and relieved the suffering, which up to that time no form of therapy had been able to combat.

Secondary eczematous changes may be healed by roentgen-ray treatment, but in general this has not had much influence on the itching or papular eruption, although Brown and Chargin have noted improvement from x-rays, and I found them curative in 2 cases. The best results are obtained by one suberythema dose of radiation filtered through 3 mm. aluminum, repeated after a month if necessary. Unaffected parts should be shielded, and the roentgen therapy stopped if there is no benefit after the second exposure. Epilation without the production of an erythema is desirable.

Chromidrosis (*seborrhea nigricans*), **uridrosis** (*sudor urinosus*), **hematidrosis** (*bloody sweat*), and **phosphoridrosis** are exceedingly rare functional disorders, dependent upon systemic disturbances, toward which treatment should be directed.

Granulosis rubra nasi (*perisyringitis chronica nasi*, *dermatitis micropapulosa erythematosa hyperidrotica nasi*) is a rare disease of undernourished children occurring on the nose and characterized by a diffuse redness, persistent hyperidrosis and small red papules, which disappear on diascopic pressure. Treatment is systemic, all local measures generally being unsuccessful. Brandle and Winfield reported some benefit from *x*-rays, but with relapses.

Hydrocystoma is an uncommon condition of the face and neck in which numbers of small isolated subepidermal cysts due to dilatation of the sweat glands or ducts appear on otherwise normal skin. The lesions are rounded, clear, tense, deep seated, pinhead to pea sized and noninflammatory. The cysts have no tendency to rupture, but in the course of several months dry up spontaneously. They are arranged symmetrically, chiefly on the forehead and malar regions. The affection occurs mostly in middle-aged women who are unduly exposed to heat as cooks or washerwomen in the summer months. Histologically, the vesicles arise from dilatations of the excretory duct of the sweat glands in the lower part of the corium.

The lesions disappear after a few fractional, unfiltered *x*-ray treatments, but usually recur unless the cause is removed by avoidance of exposure to heat.

Pompholyx (*cheiropompholyx*, *dyshidrosis*) is an inflammatory affection of the hands and feet, characterized by deeply situated vesicles, hyperidrosis, and often by burning or itching. Many cases formerly given this diagnosis have proved to be the vesicular type of dermatophytosis or occupational dermatitis. The application of the term "pompholyx" is at present limited to those typical eruptions which have small deep-seated vesicles, usually on the palms, soles and interdigits, accompanied by itching or burning, and excessive perspiration, in which careful examination fails to reveal fungi or external chemical cause. The distribution of the lesions is as a rule bilateral and roughly symmetrical and sometimes they are arranged in groups. By coalescence of several contiguous vesicles, bullae may be formed. The contents are at first clear and colorless, but soon become straw-colored or purulent. Attacks generally last a couple of weeks, but on account of the tendency to relapses the condition may persist for long periods. Due to secondary infection by cocci, occasional cases may develop lymphangitis and constitutional symptoms.

The condition responds readily to fractional doses of *x*-rays, but may recur in the course of six months or a year. Usually two or three exposures of $\frac{1}{4}$ E. D., unfiltered, at weekly intervals are sufficient. When the hyperidrosis is persistent and annoying, it should be given separate treatment.

Hypertrophy and **atrophy** of the sweat glands may be congenital or acquired, localized, or generalized. Hypertrophy is usually concomitant with hyperidrosis and chronic febrile diseases. It may be controlled by roentgen therapy. Atrophy or complete absence of sweat glands is observed in cases of congenital ectodermal defect, senility, radiodermatitis, peripheral nerve injuries, or local destruction from pressure.

KERATOLYSIS EXFOLIATIVA

Under this title Wende described a superficial exfoliative condition of the palms and soles characterized by an absence of inflammatory changes, and by pinhead-sized white spots in the beginning, which gradually extend peripherally; while at the same time the epidermis in the central part becomes ruptured and peels off. The disorder spreads, new spots developing, and eventually by coalescence the entire part shows flaky scales. The condition may affect the dorsa of the hands and feet, or appear upon the wrists and ankles. Usually the involvement is bilateral and occurs in association with dyshidrosis, although at times no cause can be ascertained. The disorder must be differentiated from dermatophytosis, eczema, and seborrheic dermatitis. Treatment is rarely of much benefit, although relief may temporarily be given by fractional doses of *x*-rays and by creams.

SEBORRHEA

"The term *seborrhea* has been extensively applied, not alone to functional hyperactivity of the sebaceous glands, but to several scaling dermatoses—such as pityriasis capitis, seborrhea sicca, and seborrheic dermatitis. MacLeod has pointed out that the latter affections are probably of microbic origin and that, although they occur as a rule in a greasy skin, the greasiness only acts as a predisposing factor, by rendering the soil more fertile for the growth of the causal microbe.

"Seborrhea in itself is of comparatively little moment, unless in exceptional cases where it causes a sallow greasy complexion with plugged prominent follicles. It is important, however, as a predisposing cause of a well known group of cutaneous diseases, as it forms an excellent medium for the growth of micro-organisms and enables microbes, which ordinarily live a harmless saprophytic existence on the skin, to flourish even to the extent of becoming pathogenic and producing dermatitis.

"The most important of these micro-organisms are: (1) The micro-bacillus of Sabouraud or acne bacillus, which is believed by certain writers to be capable of transforming a sebaceous plug into a comedo, and by others of producing suppuration and the formation of an acne pustule; (2) the flask bacillus, which some consider to be the cause of pityriasis capitis and the dry forms of the so-called 'seborrheic dermatitis'; (3) the gray coccus which is believed to be responsible for the inflammatory disturbance in seborrheic dermatitis."

The morbid conditions which occur on seborrheic soil are:

"1. Seborrhea capitis (seborrheic baldness).

"2. Seborrheic dermatitis, seborrhea corporis, or seborrheic eczema.

"3. Acne vulgaris; a condition invariably preceded by seborrhea; the comedo, or blackhead, which is the origin of the trouble is derived from the fatty plug at the mouth of the sebaceous follicle.

"4. Papular seborrhoides of the face; these consist of miliary perifollicular papules which occur in association with rosacea.

"5. Seborrheic warts; these are warty growths which are liable to become epitheliomatous and are probably of microbic origin; they are generally believed to occur most readily on a seborrheic basis.

"At the present time the tendency is to limit the term 'seborrhea' to a functional disturbance associated with increased production of sebum, either in the form of small beads of oil or of cheesy plugs which can be readily expressed from the follicles." The condition is most frequent in brunettes and is often associated with hypertrichosis, coarse skin, and large pores.

The medicinal treatment of oily scalp, hair, and skin is described on page 500 (Acne). Coarse skin and large pores may be improved by peeling doses of ultraviolet light, in accordance with the technic described for the treatment of scarring after acne, page 497. The benefit is not apparent until three or four weeks after the erythema and peeling have subsided.

Milium is the name for the tiny white, cystic excrescences appearing on the face, especially under the eyes. These often accompany seborrhea and are removed by puncturing and pressing out the enclosed material, or when there are many of them which continue to recur, they may be treated by using a fine pumice stone once a week for cleansing the areas.

Diseases of the sebaceous glands which are not of functional origin are taken up under various specific affections.

DISEASES OF THE NAILS

Pyogenic and mycotic infections of the nails have been considered on pages 530, 574, respectively; and affections of the nails in eczema, psoriasis, and radiodermatitis under those headings. Congenital deformities, injuries due to other physical or chemical agents, systemic diseases, and nerve lesions form complicated subjects, which, aside from the descriptions given in larger text-books, are especially dealt with in books on Diseases of the Nails.

From the appearance of the diseased nail it is difficult to judge its etiology. The pathologic changes may be classified as follows: *Simple hypertrophy* (onychauxis), which generally involves all the nails, occurs in acromegaly and in the clubbed fingers of diseases of the heart and lungs. *Hypertrophy* with *deformity* (onychogryphosis) is often the result of pressure or injury, which gives rise to ingrowing toe-nails, *et cetera*. *Anonychia* may be congenital, or acquired as the result of infection, trauma, or nerve lesions, although more frequently there is only temporary *shedding of the nails*, which also occurs in exfoliative skin diseases. *Dystrophy* causes changes in the color and texture of the nails, due to systemic diseases, nervous disorders, certain skin diseases, and fungous or pyogenic nail infections. The principal alterations are striations, transverse grooves, stippling, white markings—leukonychia and spoon-shaped nails. Three varieties of leukonychia are recognized: (1) Leukonychia punctata; (2) leukonychia striata, and (3) leukonychia totalis.

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CHAPTER XXXIII

DISEASES OF THE MUCOUS MEMBRANES

The diagnosis of lesions on the mucous membranes is more difficult than that of lesions on the skin. There are less contrast of color and greater likelihood of alterations in the original appearance on account of secondary factors, such as maceration from moisture, abrasion from foodstuffs and teeth, and infection. Vesicles and bullae rapidly rupture to form grayish erosions and the epithelium covering papules becomes a soggy lactescent membrane, which is easily rubbed off, and thus an ulcer is formed. Grouping and distribution are less distinctive in the mouth than on the skin, and not infrequently it is necessary to establish the diagnosis by the character of associated cutaneous lesions or by the observation of subsequent developments, as in pemphigus.

CHEILITIS EXFOLIATIVA

Under this caption a group of exfoliative conditions of the lips is included· The lips are chronically inflamed and covered with crusts which from time to time tend to desquamate, leaving a glazed surface upon which new crusts form. Fissures may be present and there may be burning sensations, tenderness, and some pain. The lower lip is the more often involved, the inflammation being limited to the vermilion part. In some instances the cheilitis is secondary to eczema or seborrheic dermatitis or pyorrhea alveolaris, and in others the cause is unknown. Irritating lipsticks, tooth pastes, and mouth washes may be causative factors. Women, particularly those of nervous temperament, are more frequently affected than other persons and in them the disorder runs a chronic course.

The treatment is often unsatisfactory but some improvement follows local hygienic measures, the regulation of diet, and the administration of alkalies when indicated. Locally, ointments containing 1 per cent ammoniated mercury, 2 per cent yellow oxide of mercury, 5 per cent naphthalan, or 20 per cent solution of aluminum acetate are beneficial. When there are fissures silver nitrate or *x*-rays should be used, the latter being a most effective method. Fractional unfiltered technic is employed, $\frac{1}{4}$ E. D. being given weekly for three or four exposures, with the surrounding parts shielded. If more than this number of exposures is given, the dosage should be lowered to $\frac{1}{8}$ E. D. in order to avoid an *x*-ray reaction, as mucous membranes are more sensitive than the skin. Exposures of unfiltered radium in doses of 25 millicurie minutes per square centimeter, in contact, may be given to the mucous surface (half-strength 10 mg. flat applicator, contact ten minutes).

CHEILITIS GLANDULARIS

Cheilitis glandularis, sometimes termed "cheilitis glandularis apostematosa," causes patulous openings of the ducts of the mucous glands, cysts, and general enlargement of the lips. Mucus exudes freely and forms a gluey film over the lips, which dries and causes them to stick together, especially during the night. When the lip is palpated between the thumb and index finger, the enlarged mucous glands feel like pebbles beneath the surface.

Sutton suggested the congenital origin of this affection. I have had under treatment for several years two brothers with typical involvement, neither of whom has associated catarrhal condition of the nose and throat, although this feature has been recorded in some cases.

The treatment, consisting of a combination of destruction of the cysts with inhibition of glandular activity, is unsatisfactory. The cysts are destroyed by excision of the individual lesion by means of a small skin punch or by incision, drainage, and curettage of each lesion followed by cauterization with phenol or the electric spark. Glandular inhibition is obtained by *x*-ray therapy. The radiation should be filtered through 3 mm. of aluminum and the dosage should be kept below an erythema. Three fourths of an erythema exposure may be given and repeated after an interval of six weeks.

FORDYCE'S CONDITION

This affection is the anomalous presence of enlarged sebaceous glands clinically characterized by minute whitish or yellowish, elevated or flat pinhead-sized spots on the mucosa of the lips, cheeks, and gums. Sites of predilection are the lips near the commissures and the oral mucosa extending along the line of the teeth. The overlying epidermis is hypertrophied. Chambers has demonstrated the structure of the condition by wax models. Goeckerman has reported a case of involvement of the penis, and Barthlemy a similar condition on the labia minora.

Fordyce's condition may be confused with lichen planus, but in the latter the mucous membrane lesions are whiter and arranged in reticular or annular patterns and tend to be situated more on the buccal mucosa than on the lips. There are no indications for treatment because the anomaly is asymptomatic and inconsequential. Electrolysis may be employed if desired.

KERATOSES

Closely related to chronic cheilitis is a condition of circumscribed or diffuse keratosis of the lips, almost invariably occurring on the lower lip. It is preceded by an abnormal dryness of the lip and may be caused by chronic irritation, from smoking or exposure to the elements. Lichen planus, lupus erythematosus, and similar affections are now identified separately, but formerly were comprised by the general term "leukokeratoses." Keratoses sometimes occur at the mucocutaneous junctures, having a tendency in such locations to form small cutaneous horns. Keratoses of the oral cavity form an important group of epithelial hyperplasias which are regarded as precancerous lesions. It is often impossible to tell whether we are dealing with an early malignancy or with one of these keratoses. Invariably tumors developing upon them in these locations are metastasizing squamous-cell carcinomas.

In mild cases of keratoses, removal of the irritative factor and the use of a bland ointment, such as diachylon, may prove curative. Intractable lesions may be treated by thorough cauterization with a Paquelin cautery or by electrodesiccation. Radium is also a good remedy. The beta rays are used, as a rule, from a flat glazed salt applicator, unscreened, in a dose sufficient to cause a caustic reaction and the exfoliation of the keratosis (half-strength plaque, contact one to two hours). The same effect may be produced more rapidly and conveniently by using an emanation plaque consisting of bare glass tubes applied in contact for a dose of 200 to 300 millicurie minutes per square centimeter of surface area. If there is any underlying infiltration, or palpable submental or submaxillary glands, suspicion of carcinoma should be aroused and the lesion, by a V-shaped incision, should be widely removed for microscopical examination.

LEUKOPLAKIA

Synonyms.—Leukokeratosis, ichthyosis glossae, psoriasis buccalis.

Leukoplakia is a whitish thickening of the epithelium of the mucous membranes occurring as lactescent superficial patches of various shapes and sizes, which may coalesce to form diffuse sheets. The surface is generally glistening and opalescent, often reticulated, and may even be somewhat pigmented. The white pellicle is adherent to the underlying mucosa and attempts to remove it forcibly cause bleeding. At times it is a thick rough elevated plaque. The lips, gums, cheeks, and dorsum of the tongue are the most common sites, but lesions may arise upon the genitalia. Leukoplakia is met with chiefly in males over forty years of age. Out of 848 cases Cumston found but 30 in females.

The disease varies in appearance according to its duration and stage. In early lesions the affection is superficial and gives rise to no symptoms, or causes the areas to be specially sensitive to hot and spicy foods. There are minute, punctate, smooth, bluish-white spots or streaks; later these become thickened and stiff, their surfaces showing tiny criss cross furrows. The course of the disease is extremely chronic. In old lesions the epithelium may be desquamated and there may be fissures or ulcerations. Such changes are associated with more or less hyperemia and tenderness, and with a tendency to bleed after slight trauma.

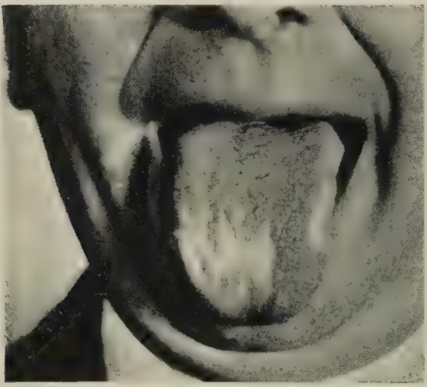

Fig. 925.—Leukoplakia of upper surface and lateral margin of tongue.

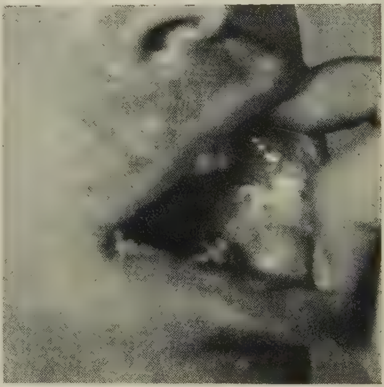

Fig. 926.—Leukoplakia of the buccal mucosa.

Causative Factors.—Syphilis as a precursor of the disease, and cancer as a possible complication are perhaps the most important features to bear in mind. The relationship of syphilis to leukoplakia is still a matter of discussion. It is freely admitted that syphilis plays an important rôle as a provocative factor, but statistics vary widely concerning the frequency of the combination. Statistics tend to place the incidence of syphilis between 65 and 80 per cent in cases of leukoplakia. Elliott and Stookey have called attention to the frequency of leukoplakia in cases of syphilis of the cerebrospinal system. The Wassermann reaction is not constantly positive in cases of syphilitic leukoplakia and the syphilitic nature of the process is not always easy to prove, although it may be strongly suspected when the leukoplakia is associated with a superficial glossitis, smooth atrophy or a sclerosis of the deeper parts of the tongue. It was formerly thought by most authorities that leukoplakia was practically always due to syphilis, but at present it is generally conceded that many cases occur in nonsyphilitics. The syphilitic who smokes, however, is highly predisposed. Cases in nonsyphilitics develop as the result of excessive smoking, poorly fitting dental plates, projecting teeth, and other sources of local irritation.

Relationship to Cancer.—Extensive involvement of the lips and oral cavity with leukoplakia may exist for years without any indication of carcinoma, but, on the other hand, small inflamed patches may be the site of a rapidly growing tumor, which, with relatively insignificant local infiltration, may early involve the cervical lymphatics. Carcinoma on leukoplakia usually begins as a localized induration, often about a fissure; or a warty excrescence which rapidly becomes ulcerated.

Treatment.—The disease is refractory to any form of therapy. Antisyphilitic treatment of syphilitic leukoplakia is rarely beneficial and may make the lesions much worse, probably because of added irritation due to the drugs used. Mercury, bismuth, and iodides are objectionable and even arsphenamine is not well tolerated. If there is the slightest suspicion of carcinoma, antisyphilitic treatment should not be given, for, while such a "therapeutic test" is being carried on, the case may pass from the operable stage into the inoperable one. In view of these objections, antisyphilitic treatment of leukoplakia is generally condemned, although there may be isolated instances of a mild type with a strongly positive Wassermann test, or deep syphilitic sclerosis, in which arsphenamine may be given over a long period, but such cases should be kept under close observation. Due to the fibrosis, the amount of treatment necessary for interstitial glossitis, with or without surface keratoses, is comparable to that required in types of visceral syphilis such as interstitial hepatitis.[1] Macroglossia may be reduced to normal size and fissures and keratotic patches dissipated, so that there is little evidence of the former condition, except areas of smooth atrophy and scars.

It is evident that carcinoma results only in those cases subjected to continued irritation. Therefore, in small leukoplakic spots, prophylactic treatment by the removal of possible irritants is often sufficient treatment. Dental plates, projecting, irregular or dirty teeth, and pyorrhea should be corrected, and smoking and the indulgence in alcohol prohibited. With these simple precautions and the observation of the patient at intervals of six months, it is frequently unnecessary to pursue further therapy. Bloodgood states: "As long as the leukoplakia shows no tendency to crack or peel off or form an ulcer there is no indication for any treatment other than the removal of the causes—tobacco, teeth, and syphilis."

Inactive persistent patches may be removed by means of the actual cautery, electrothermic destruction, or refrigeration. When the patches are inflamed, desquamative, fissured, or ulcerated, they are best removed by the actual cautery. Leukoplakia of the genitalia is also treated by the actual cautery, anesthesia being obtained by perineural injections of novocaine about the inferior pudendal nerves, and into the skin encircling the base of the genitals.

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[1] Fordyce, J. A., and MacKee, G. M.: Diseases of Oral Mucosa, Arch. Dermat. and Syph., 13: 639, May, 1926.

Radium may be used, but is not, as a rule, as effectual as the actual cautery. When the areas are superficial and not infiltrated, the beta rays from unfiltered radium in doses of 500 millicurie minutes per square centimeter in contact with the surface are employed. This treatment causes a local intense inflammatory reaction which subsides about six weeks after exposure with simultaneous disappearance of the leukoplakia and healing of the ulceration. Where the eruption is verrucous or papillomatous it is advisable to use more penetrating radiation, a dose large enough to effect destruction of the papillary body being given. Occasionally secondary infection leads to an underlying infiltration which is difficult to distinguish from neoplastic changes, but it is best to treat all infiltrated cases radically. Gold implants are inserted in dosages of 2 to 3 mc. per cubic centimeter or removable platinum implants are tied in place, or external radiation is applied from ½ mm. silver tubes in dental molding compound for 60 millicurie hours per square centimeter; or the electrothermic cutting current is used to remove a portion of the tongue wide beyond the indurated spot. As a general principle, a part at least twice the size of the definitely affected area should be removed. Although this kind of treatment is often in itself successful, it is safer to supplement it by the use of interstitial radiation.

PAPILLOMA

Papilloma of the tongue and the buccal mucosa must be differentiated carefully from carcinoma. This is best accomplished by microscopical study. With the loop of the high frequency cutting current, these lesions may be readily and thoroughly removed for this purpose.

FURROWED TONGUE

Synonyms.—Scrotal tongue, grooved tongue, lingua plicata.

This affection is a congenital and sometimes familial condition of the tongue in which the organ is generally larger than normal and there are plicate, superficial, or deep grooves, usually arranged so that there is a longitudinal furrow along the median raphe, with shorter grooves on each side.

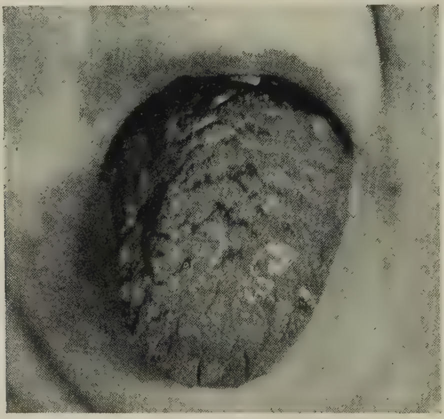

Fig. 927.—Furrowed tongue.

The condition gives rise to no difficulty, and treatment is not necessary, except that deep furrows should be kept clean with mouth washes. Furrowed tongue must be differentiated from the cobblestone tongue of syphilis.

BLACK HAIRY TONGUE

Synonym.—Hyperkeratosis linguae.

This affection is rare, usually occurring on the dorsum anterior to the circumvallate papillae, where there are formed black, bluish-black, or brown patches consisting of hairlike intertwining filaments from ¼ to ½ inch in length.

Histologically, Heidingsfeld found elongated and stratified filaments originating from abnormal papillae within the epithelial covering of the mucous membrane. The cells making up the hairlike processes resemble those in the stratum corneum of the skin. The color is due to changes in the horny cells analogous to those which are seen in certain types of hyperkeratosis of the cutaneous surface, or to pigment from substances taken into the mouth. The condition is not due to micro-organisms, but to some congenital abnormality which develops in later life.

Pseudoblack tongue may originate from local irritants or mouth washes containing coloring matter. Oppenheim demonstrated that hypertrophy and hyperkeratosis of the filiform papillae in this region can be experimentally produced by daily applications of tinctures containing vegetable coloring matter. He compares the artificially produced condition of the tongue with hyperkeratosis of the skin from tar and aniline products. Prinz believes the pigmentation of the elongated filiform papillae is always due to a deposit of pigment from external sources. He was able to demonstrate iron pigment on the filaments of black tongue by chemical tests and believes the condition is due to a chemical reaction between the hemoglobin in the blood and certain sulphur and ammonia compounds derived from the decomposition of protein débris or tobacco.

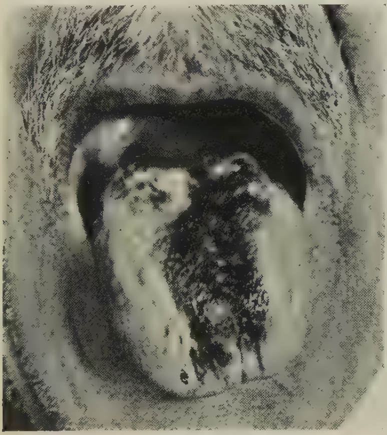

Fig. 928.—Hyperkeratosis linguae.

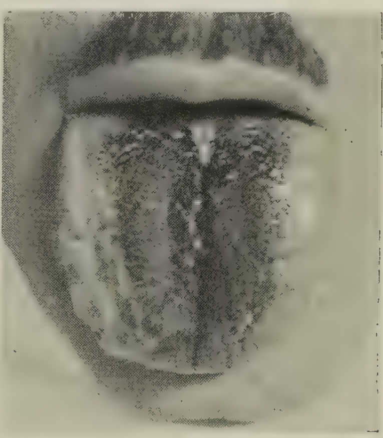

Fig. 929.—Mycotic tongue.

Another form of pseudoblack tongue is caused by the filamentous mycelia of fungi which grow as molds on the dorsal surface. The diagnosis is confirmed by microscopical demonstration of the fungus and by the ease with which the filaments can be removed from the tongue. Thompson and Montgomery, in a study of two cases, isolated pure cultures of actinomycosis from each. Weidman recovered a similar organism (Microsporon minutissimum) in a case of black tongue occurring in a diabetic who also had erythrasma.

The treatment varies according to the cause. It consists of mouth washes containing 1 to 2 per cent formalin, potassium chlorate, or boric acid, or of painting the part with tincture of iodine; in resistant cases electrodesiccation is advisable.

LINGUA GEOGRAPHICA

Synonyms.—Erythema migrans, geographic tongue, transitory benign plaques of tongue, pityriasis linguae, glossitis areata exfoliativa.

This is a rare affection of unknown origin which usually occurs in adolescence, and is sometimes met with in adults. It begins with a small, reddish elevation on the dorsum or the tip of the tongue which spreads peripherally with the formation of sharply circumscribed ringed or gyrate red patches, with a narrow yellowish-white border. The appearance changes from day to day; patches disappear in one place and manifest themselves in others. Probably recognition of the condition is frequently missed because it occasions no symptoms. The etiology is unknown.

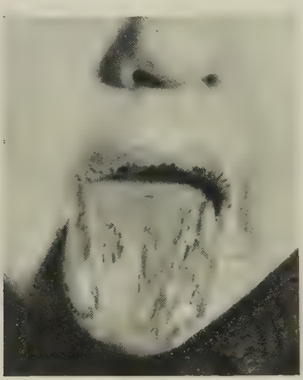

Fig. 930.—Lingua geographica.

Fractional x-ray therapy, $\frac{1}{4}$ E. D. at weekly intervals for three exposures, frequently causes complete involution, after which, however, recurrence may occasionally arise. Other therapy is totally unsatisfactory.

MOELLER'S GLOSSITIS

This affection is predominately a sensory nerve disturbance of the tongue' which, however, is accompanied by slightly reddened patches denuded of epithelium. These patches may be an inch or more in diameter and are whiter than the remainder of the tongue, with sharply defined margins. The accompanying pain may be felt in other parts of the tongue, but it is usually limited to the patches denuded of epithelium. The sensory disturbances are aggravated by the contact with food. The cause is unknown, but possibly a neuritis is responsible for the affection. No form of treatment is curative.

GLOSSITIS RHOMBICA MEDIANA

This is a peculiar affection of the tongue which is characterized by a smooth, shiny elevation, invariably situated on the dorsum in the middle of the posterior part immediately in front of the circumvallate papillae. The surface is abnormally red; and pinhead-sized pale yellow papules generally may be discerned on it. On palpation the lesion feels slightly firm, but it causes no symptoms and is discovered by accident. It persists indefinitely with little or no increase in size. Histologically the changes are those of a simple, chronic inflammation with fibrosis. Fordyce and Cannon treated one patient with the affection successfully by surgical diathermy.

APHTHOUS STOMATITIS

This affection of the oral mucous membrane is most common in children and begins as small yellowish, discrete, or grouped papulovesicles, which in a few hours become tender ulcerations. The onset may be associated with dietary indiscretions, upset stomach, and slight fever. By the time the mouth lesions are inspected they are usually ulcerated. In appearance they are small round, shallow, grayish erosions, generally surrounded by a ring of hyperemia. As a rule, they are tender, but they may be so painful that they interfere with speech and mastication. The edges of the tongue and the buccal mucosa are the sites most often involved. At times two or three neighboring lesions may coalesce to form a sizable erosion. The affection tends to disappear in two or three weeks, but recurrences are common.

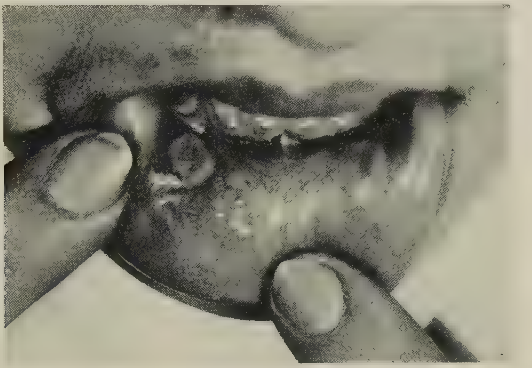

Fig. 931.—Aphthous stomatitis.

The treatment is largely internal. The diet should be bland, all raw fruits, wines, and acid foods being avoided. Milk of magnesia is given internally. An alkaline mouth wash should be used. The lesions should be touched with 10 per cent silver nitrate solution, or with powdered alum.

PERIADENITIS MUCOSA NECROTICA RECURRENS

This affection of the mouth causes small shotlike nodules which break down into sharply circumscribed ulcers. The latter are painful, last a week or ten days, and then heal with slight or no scarring, but fresh outbreaks are likely to occur over a long period. The condition has been studied by Sutton. The treatment is difficult and must follow suggestions obtained by a careful general examination and those outlined for aphthous stomatitis.

VINCENT'S ANGINA

Synonyms.—Ulceromembranous stomatitis (Plaut-Vincent), trench mouth, Vincent's disease.

This is an infectious, relapsing, ulcerative affection of the mucous membranes, often secondary to swollen and bleeding gums, carious teeth, or enlarged diseased tonsils. The Bacillus fusiformis and Vincent's spirillum are causative agents. The ulcerations are superficial, tender hyperemic patches covered by a grayish membrane, the removal of which leaves a raw and bleeding surface. Multiple ulcerations are uncommon.

In order to prevent relapses, infected tonsils should be removed. Treatment consists in dental repair and oral hygiene. Arsphenamine solution, 1 : 1000 in glycerin, is used locally and between the teeth on dental floss. Arsphenamine is also given intravenously with benefit. Sodium perborate is valuable as a local dusting powder. The chemically pure salt made into a paste with water is spread over the teeth and on any inflamed or ulcerated patches near the teeth with the fingers, which have been thoroughly cleansed. This paste, which becomes oxidized, is kept in the mouth for five minutes, then is washed out with warm water. It is necessary to have the patient go through this procedure under direction, and the frequency should be regulated to avoid irritation. A salt solution is used as a gargle if the mouth and throat are affected. Another beneficial mixture is of the following formula:

℞.	Liq. potassii arsenitis (Fowler's)	ʒij
	Syrup ipecac	ʒss
	Glycerite of tannin q.s. ad.	℥ij

M. and S. Paint locally and use on dental floss.

Greenbaum reported 2 cases of fusospirillary dermatitis, one of the external auditory canal and the other of the hands and vulva—the latter apparently one of acute pellagra with fusiform bacilli and spirochetes complicating the oral, vulval, and cutaneous manifestations.

MUCOUS CYST

A retention cyst may be formed from a mucous gland in the lower lip or tongue, usually occurring as a rounded projection covered by pale, but otherwise normal mucosa. On the lip the growth is generally the size of a small nut, but on the tongue may be the size of a hen's egg; it is painless, and fluctuant when palpated. When the lesion is incised, a viscid straw-colored fluid escapes. After the cyst is thoroughly evacuated in this manner, the lining membrane is destroyed by the use of phenol or the actual cautery.

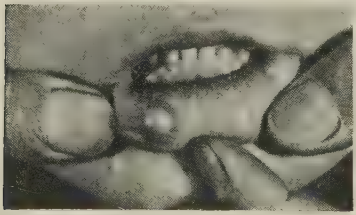

Fig. 932.—Mucous cyst of lip. (Courtesy of Drs. J. B. and Bedford Shelmire.)

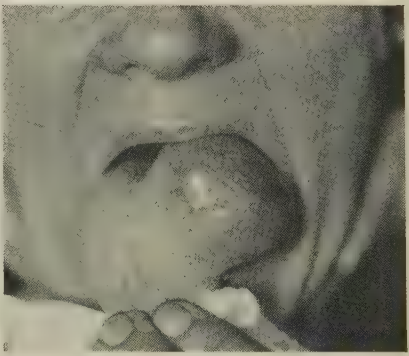

Fig. 933.—Mucous cyst of tongue. (Glossocele. (Courtesy of Dr. L. Hollander.)

MISCELLANEOUS AFFECTIONS OF THE ORAL MUCOUS MEMBRANE

The mouth and nose form an entry to many systemic infections (cerebrospinal meningitis, measles), and local processes on the oral and nasal mucosae are frequently related to other general diseases (rheumatism) or skin manifestations (erythema multiforme, purpura). These membranes may also be secondarily encroached upon by diseases of adjacent parts of the skin (carcinoma, tuberculosis, syphilis, gangosa, yaws, rhinoscleroma) or may be involved solely, or together with other visible parts by such diseases as herpes, actinomycosis, hydroa, pemphigus, erythema multiforme, drug eruptions, Addison's disease, the lymphoblastomas, melanosis, lichen planus, psoriasis (lips), lupus erythematosus, neurotic excoriation. Benign and malignant neoplasms may be primary in these parts, chiefly carcinoma, angioma, lymphangioma, and fibroma. Glossitis also occurs in pernicious anemia and gastrointestinal diseases, and stomatitis arises from the use of mercury, bismuth, phenolphthalein, bromides, coal tar hypnotics, and analgesics.

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CHAPTER XXXIV

AFFECTIONS OF THE CUTANEOUS BLOOD VESSELS

The cutaneous blood vessels are affected in most skin diseases, and circulatory and vascular alterations are the predominant features in many conditions which have been described elsewhere. There remain for consideration the purpuras, the varicosities. and the telangiectases.

PURPURA

The condition called purpura is an eruption of reddish or purplish spots due to extravasation of blood into the skin or mucous membranes. It is a symptom produced by a variety of causes. Several types of the affection are recognized. The term "petechiae" is applied to superficial, pinhead to pea-sized, rounded hemorrhagic spots, which at first are bright red and later become brownish or rust colored. Ecchymosis ("black and blue mark") signifies a deeper and more extensive interstitial hemorrhage, forming a non-elevated, rounded, or irregular purple or blue patch which gradually becomes yellowish, and fades. Hematoma designates a pool-like collection of extravasated blood in a "dead space" in tissue, which, if of sufficient size, produces a swelling which fluctuates on palpation. It is customary to classify purpuric conditions into those of a primary nature and those which are secondary to other conditions.

Primary Purpuras.—These are divided into four groups: Purpura simplex, Henoch's purpura, purpura rheumatica, and purpura hemorrhagica. Persons with the primary type of purpura frequently harbor virulent streptococci in their tonsils or in other foci.

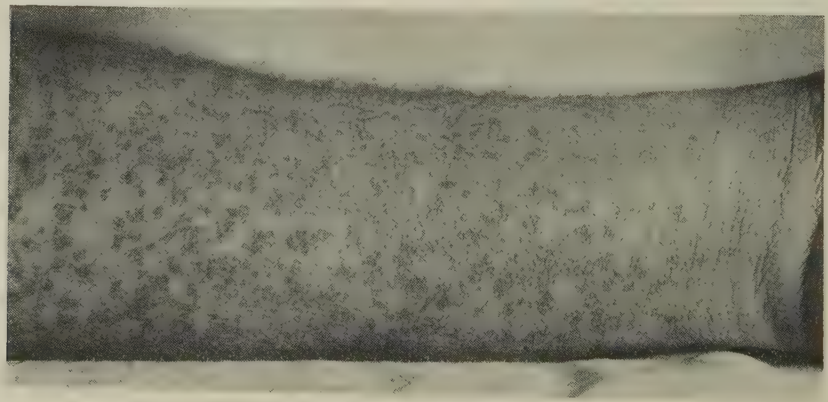

Fig. 934.—Purpura simplex.

Purpura simplex comprises the mild eruptions of petechiae encountered chiefly in children, which affect principally the legs and the buccal mucosa. The lesions come out suddenly, reach their height in a few days, and then gradually fade. Successive crops appearing throughout several weeks or months are a common course for the affection. Occasionally there are mild constitutional symptoms. A similar condition occurs in senescence, and is called "purpura senilis."

Henoch's purpura is a variety which also occurs chiefly in children, being associated with gastro-intestinal disturbances—vomiting, colic, diarrhea—and sometimes with arthritis and nephritis. Alexander and Eyermann stress the importance of allergy to foodstuffs as the cause of the combined visceral symptoms and skin lesions.

Purpura rheumatica (also peliosis rheumatica or Schönlein's disease) comprises cases in which there are sore throat, fever, and arthritis. The eruption may last for several weeks or months. The petechiae may be accompanied by urticarial, erythematous, nodular or even bullous lesions, similar to those which occur in erythema multiforme, particularly like those in erythema nodosum. There may be associated pleurisy, endocarditis, or pericarditis.

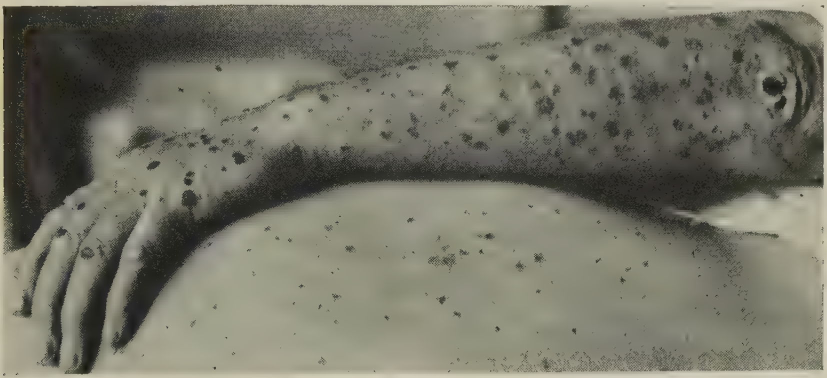

Fig. 935.—Purpura rheumatica. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

Purpura hemorrhagica (or morbus maculosus) comprises cases of a severe and frequently fatal type in which there are extensive hemorrhages into the skin, mucous membranes, meninges, and other parts. The skin lesions may be petechiae, ecchymoses, or hematomata. There may be bleeding from the gums, stomach, bowel, or genito-urinary tract. This type of purpura affects chiefly young girls, and lasts for several weeks, although it may exist in a mild form for years.

Sooy and Moise have demonstrated that there is an increase of blood platelets after an irradiation of white rats with a mercury vapor quartz lamp, and have applied this form of treatment beneficially to the disease. Stephan, in 1920, suggested irradiation of the spleen and reported that he had successfully treated 2 cases by deep roentgen therapy. Pancoast, Pendergrass, and Fitz-Hugh treated 6 cases by Stephan's method and believed that of these 4 were somewhat improved.

Secondary Purpuras.—The secondary purpuras are produced by manifold known conditions. In several skin diseases the eruptions are at times purpuric, especially in erythema multiforme, dermatitis medicamentosa, serum sickness, and herpes zoster. Petechiae or other hemorrhagic lesions may be associated with the eruptions of some exanthemata—measles, scarlet fever, smallpox—and may appear extensively in cerebrospinal meningitis and in typhus. In septicemia, bacterial endocarditis, malaria, influenza, general tuberculosis, syphilis, anthrax, and Rocky Mountain spotted fever, purpuric eruptions are seen. Severe visceral disease, affections of the blood vessels and blood-forming organs, hemophilia, disseminated malignant disease, mental and nervous diseases, and cachectic states may lead to purpura.

Purpura may also be evoked by mechanical obstruction to the circulation, with resulting stress on the small vessels, encountered in cardiac decompensation, convulsions, pertussis, and asthma. Local obstruction of the blood flow may result from compression of the veins by tumors and the gravid uterus; by occlusion from thrombosis, or by a weakening of the elastic coat as in varicose veins; and in all of these conditions purpura is observed.

The treatment of purpura depends upon the underlying cause. In the primary cases, rest in bed, with the legs elevated, is generally advisable. There are no specific remedies, but calcium lactate, 20 grains t. i. d., or, when there are rheumatic features, salicylates should be given. Injections of coagulin (Ciba) may be used, and in severe cases blood transfusion may be necessary.

PURPURA ANNULARIS TELANGIECTODES

Synonym.—Majocchi's disease.

Under the term "purpura annularis telangiectodes" are grouped cases of a rare purpuric syndrome, which apparently may be caused by various infectious and toxic agents. The clinical and histologic features are fairly well defined. The eruption begins on the lower extremities, may spread to the trunk and arms, and become generalized. The earliest lesions are bluish macules, about which satellites develop, spreading peripherally, in an annular form. The macules are superseded by bright and dark red telangiectatic puncta. Follicular involvement is common, but by no means constant. The central part of the annular lesions gradually fades, leaving brownish pigmentation, or at times scars or slight atrophy. Through peripheral extension and central involution large rings and semicircles may be formed. Involution usually requires six months to a year, but on account of relapses the affection may be prolonged indefinitely. Histologically, the changes are chiefly in the subpapillary zone. There is a perivascular lymphocytic infiltration, and there are also various degrees of endarteritis and endophlebitis, as well as occasional microscopical hemorrhagic foci. A numerical increase and a grouping of the blood vessels, in addition to minute aneurysmal dilatations, have been noted.

SCHAMBERG'S PROGRESSIVE PIGMENTARY DERMATOSIS

In 1900 Schamberg described a peculiar, slowly progressive, pigmentary disorder of the skin, which runs a characteristic course. The initial lesions are pinhead sized, reddish puncta appearing in crops and blending to form irregularly shaped patches that slowly progress outward by the development of fresh lesions at the periphery. After a few months the color of the spots begins to fade, becoming brownish and yellowish; they may resemble grains of cayenne pepper on the skin. There are no subjective symptoms, and in the course of time the affected area may assume a normal appearance. The sites of predilection are the shins, ankles, and dorsa of the feet, although the condition sometimes involves the knees and the wrists. Kingery believes that the pigmentary changes may take place in the following manner: "The circumscribed capillary proliferation suggests a local angiectatic process through which the circulation is impeded; this, in turn, giving rise to a diapedesis of red cells, followed by their disintegration in the surrounding tissue, and resulting in a pigmentation, limited by the extent to which the capillary proliferation progresses." He concludes that Schamberg's disease is a hemosideric condition secondary to a localized alteration of circulation occurring only in males, in any decade of life, and involving only the extremities. Histologically, there is a subacute inflammatory process with occasional deposits of pigment. The disease must be differentiated from purpura, particularly purpura annularis telangiectodes, angioma serpiginosum, and from dermatitis hemostatica.

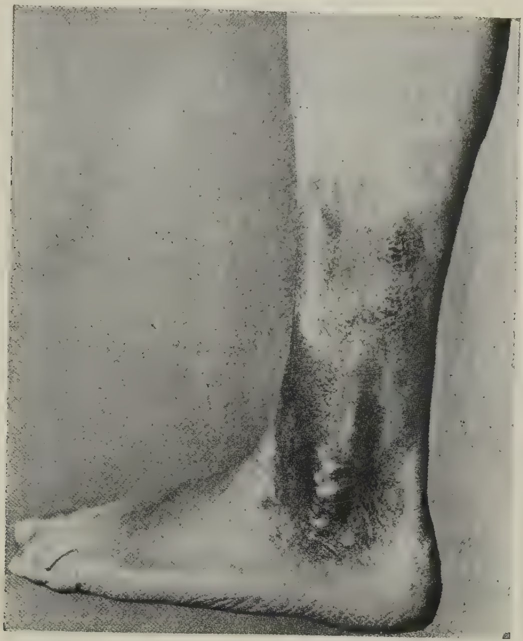

Fig. 936.—Schamberg's progressive pigmentary dermatosis. (Courtesy of Dr. Lawrence K. McCafferty.)

TELANGIECTASES

Localized dilatations of the cutaneous blood vessels occur in almost every one and at times are sufficiently prominent or numerous to attract attention. The congenital varieties (nevi) have been considered elsewhere; the acquired telangiectases will be discussed here. They are of two varieties: those which are idiopathic, and those which are symptomatic of some skin disease or systemic condition.

Idiopathic Telangiectases.—Idiopathic telangiectases are single or multiple, superficial clusters of dilated capillaries, sometimes with a central raised point; elevated papules composed of minute vessels, or plaques. They occur at all ages, and in both sexes, and on the mucous membranes as well as the skin. Occasionally on the hands and feet there may be a delicate scale on the lesion; or on the scrotum, a verrucous covering (angiokeratoma).

Hereditary Hemorrhagic Telangiectasia.—Hereditary hemorrhagic telangiectasia was described by Osler under the heading "Recurring epistaxis with multiple telangiectases of the skin and mucous membranes." It is a familial affection, the essentials of which are: (1) Frequent nosebleeds in childhood, occurring also in later life, sometimes associated with bleeding from other mucous membranes or from the skin after slight traumatism. As the patient grows older the tendency to bleeding may diminish or become worse and even lead to death. (2) There is a development of telangiectases in middle life, which increase in number with the passing years. Usually the patient presents both groups of symptoms, but occasionally one or the other may be absent. In this affection there are no evidences of hemophilia or of diminished coagulability of the blood, but stigmata of a neurotic constitution, and evidences of vasomotor instability or circulatory weakness have been noted.

Generalized Telangiectasia.—Under the title "generalized telangiectasia" are grouped those cases in which the vascular dilatations are extensive. The lesions are principally macules and intertwining lines with occasional plaques. They may occur in any areas, but rarely on the scalp, palms, soles, or genitals. The more common sites involved are the face, extensor aspects of the thighs, dorsa of the feet, and the trunk. Distribution along the course of the cutaneous nerves has been recorded, as has also unilateral involvement. Females are affected more often than males and usually during the second decade. Lanceplaine proposed three theories as to the pathogenesis of generalized telangiectasia: (1) Disturbances of the nervous system, particularly paralysis of the vasomotor nerves; (2) mechanical embarrassment of the general circulation, and (3) toxicity. According to Becker, the mechanical obstruction to circulation is practically always due to inflammatory processes in or about the vessels, subsequent to infection, although it is said to be caused by arterial spasm. The mechanical factors are a narrowing of the lumen of the smaller vessels, either from endarteritis or mesarteritis, or by compression due to perivascular fibrosis; an example of which is syphilitic panarteritis. There are also a dilatation and a proliferation of other vessels. The toxic causes, usually from the liver or kidneys, act by destroying the integrity of the vascular elements, and in the neurogenous type of the affection there is a diminution of muscle tonus due to damage to the vasomotor nerves.

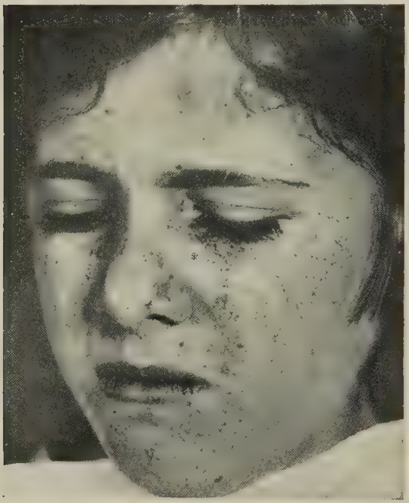

Fig. 937.—Generalized telangiectasia, which appeared after measles.

Of the variety of conditions which play a causative rôle, syphilis is probably the most important. In 1892 Elsenberg presented a case of syphilitic involvement of the cutaneous vessels, with the syndrome of Raynaud's disease, and since then numerous cases of peripheral vascular alterations (particularly telangiectasia) in syphilis have been recorded. In some cases neurosyphilis was present, and in others, diverse neurogenic factors, especially convulsions. In still other cases there was no history or signs of syphilis; but focal infections and arteriosclerosis were present, which were considered etiologic. In 1907 Ehrmann described under the title of *livedo racemosa*, a condition in young girls, probably of developmental origin, in which a coarse irregular network of purplish bands was present about the knees or on the arms. Clinically, the eruption suggested an exaggerated form of cutis marmorata or erythema ab igne. Some of these cases were shown to be on a syphilitic basis and others were of an obscure nature, probably of toxic origin. Tobacco, alcohol, arteriosclerosis, and tuberculosis are possibly responsible factors. There is apparently a constitutional predisposition of the vessels toward livedo racemosa; Ehrmann believes it always follows cutis marmorata.

Secondary Telangiectases.—Secondary telangiectases develop in the course of several skin diseases and as the result of local circulatory disturbances as in radiodermatitis, lupus erythematosus, adenoma sebaceum and keloid; in cirrhosis of the liver, cardiac disease, arteriosclerosis; in Bright's disease, hyperthyroidism and other toxic disorders. They are also features of chronic actinic dermatitis and occur in those who have been exposed for long periods to wind, cold, and heat—policemen, seamen, gardeners, golfers, stokers, cooks, *et alii;* as well as in those who have rosacea, or congestion of the face from chronic alcoholism or indigestion.

Treatment.—Telangiectases are best treated by electrolysis, the negative pole for the active electrode and a current of about 2 ma. being used. The needle point is inserted obliquely into the lumen of the vessel where it forms little hydrogen bubbles that denote its presence there. When the vessel becomes blanched and there is frothing about the needle, which takes about a minute, it is withdrawn. Ultraviolet light, refrigeration, or radium therapy may be used on extensive lesions.

POIKILODERMA ATROPHICANS VASCULARE

In 1906 Jacobi called attention to this rare skin condition, which he later described, and since that time several cases have been reported. The affection is a chronic atrophic disorder encountered in middle-aged persons, chiefly women. The earliest lesions have probably never been observed, but those

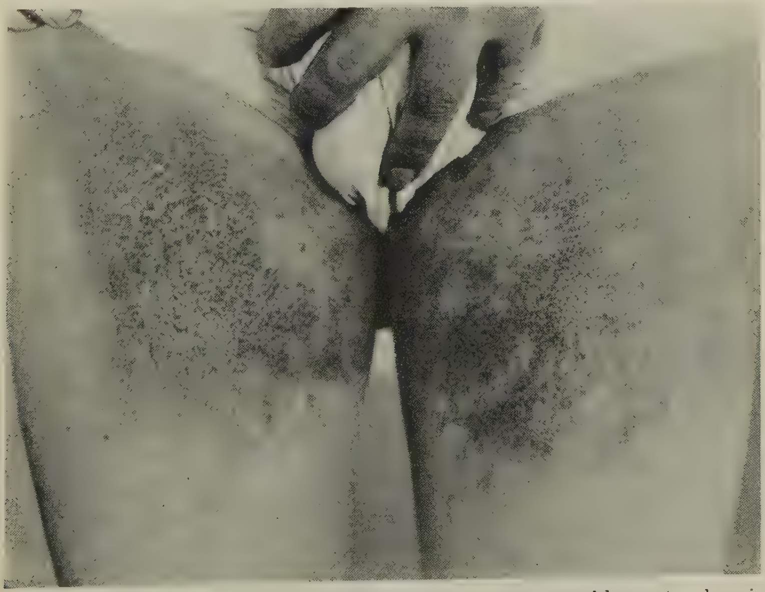

Fig. 938.—Poikiloderma atrophicans vasculare. Note the resemblance to chronic radiodermatitis.

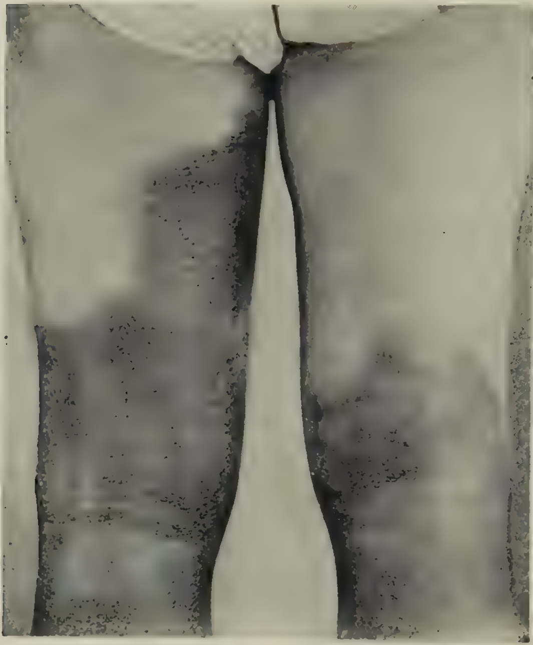

Fig. 939.—Poikiloderma atrophicans vasculare.

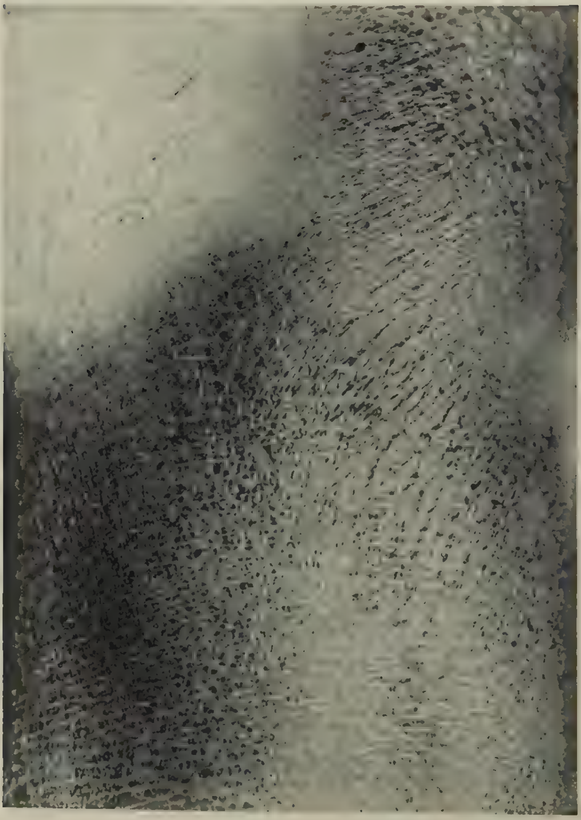

Fig. 940.—Poikiloderma atrophicans vasculare. Close-up view.

recorded consist of symmetrical and usually widespread pigmented spots and telangiectases, accompanied by general pruritus. Later there are capillary hemorrhages, with atrophy, so that the appearance simulates "x-ray skin," and these alterations may be followed by the development of ulcerations. Leukoplakic lesions in the mouth, and transitory redness and edema of the eyelids have been recorded. The course of the disease is slowly progressive and although it has no known effect upon the general health, most subjects die before reaching old age, frequently from leukemia or from cancer. The disorder must be differentiated from angioma serpiginosum, lupus erythematosus disseminatus, and radiodermatitis. Bloch and Stauffer have called attention to the causal relationship between changes in the endocrine glands and poikiloderma-like alterations in the skin.

VARICOSE VEINS

Diverse theories as to the etiology of varicose veins have been formulated, but no one explanation seems sufficient for all cases. Many cases occur in young women who have large legs and menstrual disturbances; or who in other ways suggest an endocrine disturbance of the ovaries. Other cases seem to be explained upon the basis of an inherent weakness of the component parts of the veins, associated at times with enteroptosis and flat feet. Infection, pregnancy, pelvic tumors, constipation, and hereditary predisposition may play a causative rôle.

In simple dilatation of the veins there may be no symptoms, or there may be the development of fatigue from slight exertion, or even cramps in the legs. More severe cases may be complicated by phlebitis or periphlebitis, and there may develop purpura, eczema, neurodermatitis, or ulcerations.

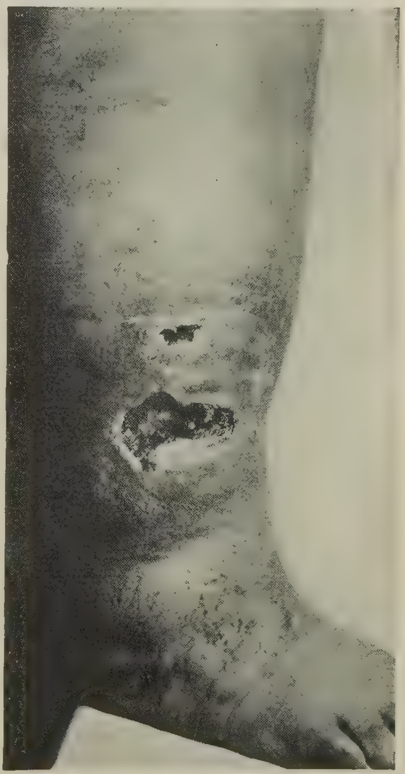
Fig. 941.—Varicose ulcer.

Treatment.—The older methods of treatment were supportive and operative, simple ligation of the veins or extensive removal being done. The supportive procedures consisted chiefly of elastic stockings and the use of Unna's gelatin-glue cast. More recently the injection of various substances into the affected veins has been used with a great deal of success—chiefly sodium chloride, glucose, and sodium salicylate in solution. The injections damage the wall of the vein and produce an artificial thrombophlebitis. The thrombi which are formed are very tenacious to the walls, so that they do not become dislodged and fragments are not detached from them. The wall of the normal vein is resistant against such injections and these effects are encountered only in varicose veins where the intima is weak. The formation of a thrombus immediately brings up the possibility of embolism, but when properly carried out this method of treatment is without danger. Relapses may occur due to the development of new varicose veins or the revascularization of those which have been thrombosed. Such recurrences may be treated by the same injection technic. These complications are less frequent after the injection method than after surgical procedures.

The technic as described by Cannon and Lowenfish, with a few changes, is as follows: The leg is scrubbed thoroughly with hot water and soap and sponged with alcohol. While the patient is standing, the site of injection is determined. The patient then lies down upon a table and a tourniquet is applied above the knee. The area is painted with tincture of iodine and the needle is inserted into the lumen of the vein; then the tourniquet is removed. The blood is stripped from the vein by means of the thumb and index finger of the left hand, which are placed with firm pressure on the sides of the needle and slowly separated. The injection is made with a 5 cc. syringe and a large hypodermic needle, 0.5 to 2.0 cc. of a 20 to 30 per cent solution of sodium salicylate in sterile distilled water being used. The needle is then withdrawn, firm pressure being exerted with a gauze compress for a few minutes over the site of injection to prevent the escape of the solution into the general circulation. This compression is further maintained by the application of an elastic web bandage, or a zinc-gelatin cast, according to the following formula: Zinc oxide, 1000 Gm.; gelatin, 600 Gm.; glycerin, 1400 cc.; hot distilled water,

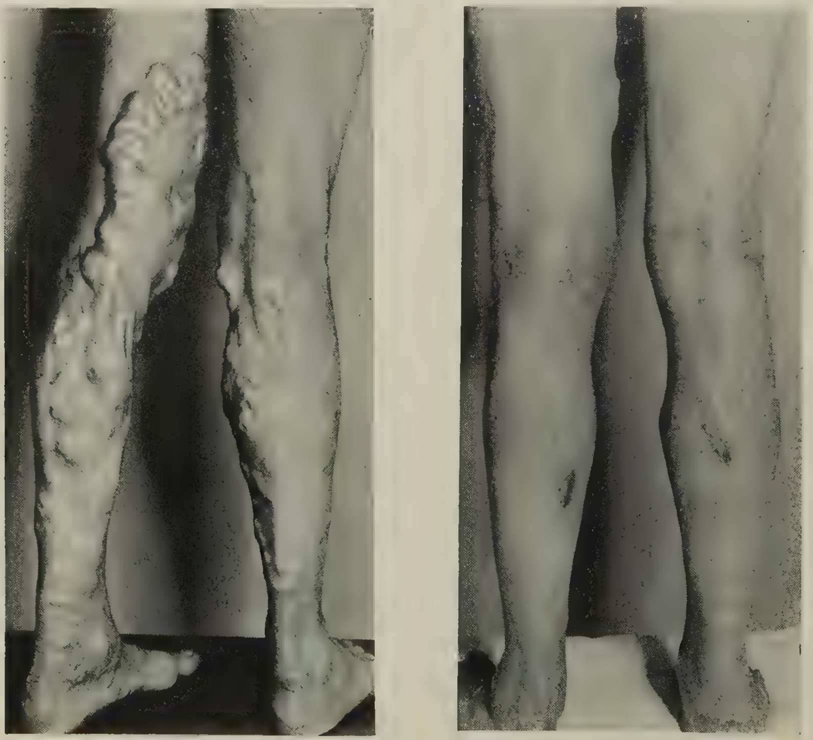

Fig. 942. Fig. 943.

Figs. 942, 943.—Varicose veins. Before and after treatment by injections of sodium salicylate solution. (Courtesy of Drs. A. Benson Cannon and Felix P. Lowenfish.)

2200 cc. A two-inch gauze bandage soaked in this warm solution is used to cover the entire leg. As the leg is encircled with the bandage it should be painted with the solution, a paint brush being employed for this purpose. The cast is left on for one or two weeks and removed only when it causes discomfort or unwarranted pressure. Injections are usually made into the veins about once a week, or whenever the casts are changed. They may be made into a single vein in several different locations, but usually not closer than 3 inches (7.6 cm.) apart. The number of treatments varies from one to seven, and the total quantity of the injected solution from 0.5 to 25 cc. This treatment is easy to carry out and may be given without confinement in bed.

When an ulcer is present, the base and edges should be curetted unless the granulations are healthy, ethyl chloride being used as a local anesthetic. The lesion is then painted with a 2 per cent solution of mercurochrome-220, and dressed with sterile gauze. As uniform support of the tissues is imperative for proper healing, no window is cut in the cast. Generally speaking, the younger the person, the more recent the ulcer, and the less extensive the surrounding sclerosis of the skin, the more rapid is the healing of the ulcer. When there are complications such as phlebitis or infarctions, Meisen recommends compression of the main trunk by pledgets of gauze placed over it and held snugly by crosswise adhesive plaster strips.

Ligation of the veins prior to injection treatment gives better results than the above-described methods. Fifteen to 30 c.c. of a 30 per cent solution of sodium salicylate are injected below the ligature. When the involvement is considerable, the operation may be repeated at different levels; but in many instances one treatment suffices. Considerable local pain may occur a few hours after the injection but otherwise the results are good.

The complications of the injection treatment are few. In a study of over 53,000 cases McPheeters and Rice, using this form of treatment, were able to find only seven deaths, of which four (0.0024 per cent) were from emboli. At times, even with good technic, superficial sloughing will supervene, especially if the vein wall is thin. Sloughs appear as tender, bluish spots surrounded by an inflammatory areola. The best treatment is to excise them and suture the edges of the wound.

Contraindications to the injection treatment of varicose veins are acute or subacute phlebitis, pregnancy, tumors or acute inflammations of the pelvic organs, local arterial disorders, or severe cardiac, pancreatic or renal disease.

Other therapeutic methods for varicose ulcers are beneficial, though usually less prompt in their effects. Patients suffering from chronic ulcerations frequently have a decreased blood calcium content, for which reason the oral administration of calcium lactate and the use of generalized ultraviolet irradiation are indicated. Ultraviolet therapy is also used locally to advantage. The lesion is carefully cleansed of all crusts and débris, and an intensive dose is given. This sterilizes the surface of bacteria, increases the circulation and stimulates the proliferation of healthy granulation tissue. After the first few exposures the pain and discomfort which usually accompany the condition disappear, and a growth of epithelium may be seen at the edges of the ulcer. These cells are very delicate and may be destroyed by subsequent exposures, so that the dosage must be moderated. Diathermy, and x-ray treatment by fractional dosage are sometimes effectual in long-standing cases with considerable fibrosis.

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CHAPTER XXXV

ANOMALIES OF PIGMENTATION

Abnormal pigmentation of the skin is produced by a variety of causes. Pigmentation due to deposits of derivatives of hemoglobin occurs in ecchymosis, purpura, and various hemorrhagic, hemostatic or vasomotor conditions. The pigmented nevi exemplify the group of cases due to the increased production of melanin. Although of congenital origin they may not become manifest until years have passed. The *Mongolian spot* probably belongs in the congenital category, although according to the dopa reaction the melanin contained in it is of mesodermal origin. Clinically, it is a rounded bluish or slate-colored discoloration generally over the sacral region encountered chiefly in infants in the Orient, being present at birth and gradually disappearing about the age of three. Accumulations of melanin likewise occur in nevocarcinoma and in melanotic sarcoma. Excessive pigmentation due to melanin is also found in acquired forms, to which the terms "melanoses" and "melanodermias" are applied. Sunburn, freckles, chronic actinic dermatitis, radiodermatitis, and xeroderma pigmentosum illustrate the acquired variety of hyperpigmentation due to melanin. *Melanodermia* may also result from long-continued exposure to heat—erythema ab igne—or from prolonged friction, rubbing, scratching, and pressure upon the skin (from garters, collar buttons, itching dermatoses) or from irritation caused by cantharides or other chemicals, especially arsenic. The pigmentation from chronic arsenical intoxication is not of a metallic nature but is due to melanin or some closely related substance. The melanotic hyperpigmentation which is usually present in lichen planus and dermatitis herpetiformis and which often occurs in eczema, psoriasis, and other skin diseases, may become greatly augmented owing to the use of arsenic in the treatment of these affections.

Melanodermia, either diffuse or localized, may be produced by several systemic diseases or by disorders of the endocrine glands or of the female generative organs. Among the systemic diseases may be mentioned syphilis, malaria, pellagra, and diabetes in which there may be a diffuse bronzing of the skin; Addison's disease in which there is a diffuse melanosis, especially pronounced in the axillae, about the nipples, and the genitals, and on the buccal mucosa. Lesions of the adrenal glands have been described in acanthosis nigricans, and possibly the hyperpigmentations which are observed in abdominal carcinoma, in tuberculosis, and in hepatic and pancreatic disease are occasioned by similar disturbances in the chromaffin system. Functional alterations in the ovaries may account for the increase of pigment during pregnancy and at the menopause. Also in hyperthyroidism various degrees of melanodermia may be present.

Chloasma is an old term used for some of these pigmentary affections of the skin. The condition occurs as multiple, but rarely numerous, smooth, nonelevated brownish or blackish patches, often poorly demarcated, generally upon the face. In addition to the facial involvement, which is mask-like, there may be a pronounced increase of pigmentation in the areolae of the nipples and about the external genitals. The affection may be idiopathic, or symptomatic of internal disorders. Chloasma is of frequent occurrence during pregnancy and at the menopause, and it is likewise seen in ovarian disorders and other derangements of the female reproductive tract. The hyperpigmentation associated with pregnancy usually disappears after this state is ended.

Treatment.—The treatment of pigmentary disturbances depends upon the cause. When the affection results from some systemic disease or internal disorder, it is likely to improve or disappear completely if the health is regained. In some cases of internal origin, glandular products are of value, especially the use of whole ovary in functional disturbances of the reproductive organs.

The treatment after determination of the cause is by peeling the epidermis with lotions containing salicylic acid or bichloride of mercury, or by the use of strong soaps, which may be left on the part overnight in the form of a plaster. In chloasma I usually recommend a facial shampoo for fifteen minutes each night before retiring and after letting the soap dry upon the pigmented area, leaving it on overnight. In the morning the area should be washed again with soap and water and some almond meal or powdered pumice, after which it may be cleansed with a 5 per cent solution of carbon tetrachloride in alcohol followed by a lotion containing bichloride of mercury, 1 : 1000, or salicylic acid, 2 per cent in alcohol. The action of these remedies may cause some redness, and such irritation when it causes discomfort should be allayed by the use of a cold cream made up with solution of aluminum acetate, 2 per cent, in place of water. The following cream may be applied at bedtime:

℞.	Citric acid	gr. v–xx
	Formalin	gtt. v
	Bismuth oxychloride	gr. xx
	Cold cream	q.s. ad. ℥j

Other bleaching preparations have been described in the treatment of freckles and acne.

RIEHL'S MELANOSIS

This pigmentary affection, first described by Riehl, begins with itching, reddening, and, desquamation, gradually spreads and, after reaching a certain extent, becomes stationary. The affection develops slowly in the course of several months and occurs in both sexes and at all ages. The characteristic feature is spotty pigmentation, light to dark brown in color. This is most intense on the forehead, on the malar regions, behind the ears, and on the sides of the neck. Numerically the spots are less toward the median line. Pigmentation on covered parts of the body is chiefly on areas exposed to friction such as the anterior axillary folds and the umbilicus. The extensor aspects of the fingers, principally over the proximal phalanges, and the frontal and temporal parts of the scalp, are affected.

In addition to the melanosis, there may be circumscribed depigmentation and temporary hyperemia. Hyperkeratosis occurs either in a diffuse manner in which the skin appears as if "dusted with flour," or in a follicular form, the latter being encountered chiefly on the dorsa of the fingers, and on the scalp. In this region the hair shafts become surrounded by gray collars of keratin, which may resemble nits.

After persistence for a long period, the hyperkeratosis disappears and the pigmentation fades, although never completely. Ultimately a growth of lanugo may be seen on the facial areas, especially on the temples.

The cause of Riehl's melanosis is unknown, but it is generally believed to be some toxin which exerts its major effects on the follicles. The condition is differentiated from actinic dermatitis by the fact that in the latter the pigmentation increases more rapidly and new peripheral pigment spots do not develop as in Riehl's melanosis. The macules are smaller, more distinctly circumscribed and less uniform in size than in arsenical melanosis. In lichen planus, pigmentation does not involve the face and scalp, but the mucosa; whereas in Riehl's melanosis only the scalp shows hyperkeratosis and the mucosa is never affected. The follicular papules and spines which are present in pityriasis rubra pilaris are absent in Riehl's melanosis. In vaselin dermatitis and occupational dermatitis (due to tar, lubricating oils, *et cetera*) the skin changes involve the entire face and neck with various degrees of inflammation, and the pigmentation occurring secondarily disappears after recovery. In Riehl's melanosis the cutaneous lesions are circumscribed, the scalp is always involved, the pigmentation is primary and although gradually decreasing in intensity, never completely subsides.

Treatment is by mild peeling lotions containing salicylic acid or resorcin. Ointments usually make the condition worse. Sunlight and ultraviolet therapy should be avoided as they aggravate the condition.[1]

BERLOCQUE DERMATITIS

In 1916 Freund described a peculiar artificial discoloration of the skin which appeared after the use of eau de Cologne followed by sea- or sun-baths. Since that time similar cases have been reported from the use of other toilet articles which contain ethereal oils, and the subject has been extensively studied. The chief offending substance is oil of bergamot, although oil of lemon, lavender, orange peel, and rosemary have occasionally caused the affection. A similar condition has been noted after the local use of benzine and alcohol, and it has even been proposed that sebum may contain an ingredient which induces the pigmentary changes without the application of extraneous substances. Experimentally the condition has been produced by the application of some of these ethereal oils, followed by exposures to the Kromayer lamp.

Clinically this pigmentary disturbance is characterized by lavalière-shaped (hanging-drop shaped) and streaked lesions which at first are erythematous and later are hyperpigmented. They are often symmetrical and are met with principally on the face and neck. There is the history of the use of eau de Cologne, or a similar article, followed by exposure to the sun.

The **treatment** is avoidance of the causative factors and by local peeling and bleaching preparations.

METALLIC DISCOLORATIONS

Pigmentation may develop from the deposit of fine metallic particles in the skin. The metal may be carried to the skin by the blood stream or permeate into it from surface applications. Argyria is a localized or widespread slate-colored pigmentation due to the presence of silver, which occurs in the skin as the albuminate. At one time when silver nitrate was used internally more frequently, argyria was encountered more often than at present. Rarely cases following the prolonged use of argyrol, protargol, and silver arsphenamine have been observed. Stillians and Lawless have successfully removed the silver deposits by injecting a mixture of 1 per cent potassium ferricyanide with 6 per cent sodium thiosulphate intradermally. The amount of reduction depends upon the rate at which the lymphatics can carry off the reducing agent. The solutions must be freshly made up and an anesthetic is required, for the injections are extremely painful. The same solutions given intravenously were without effect experimentally in a rabbit.

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[1] Kerl, W.: Melanosis (Riehl), Arch. f. Dermat. u. Syph., 130: 436, 1921. (The author is indebted to this article for much of the above material.)

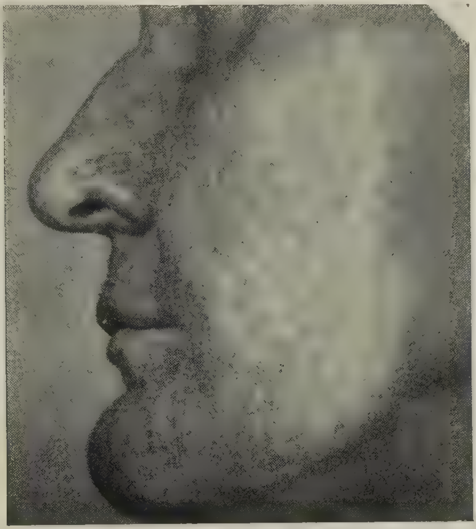

Fig. 944.—Argyria, partially treated by injections of potassium ferricyanide and sodium thiosulphate solution. The white spots are where the injections have been made. (Courtesy of Dr. Arthur W. Stillians.)

In cases of syphilis treated extensively with bismuth there may occur a deposit of metallic particles in the gums, known as the bismuth line, accompanied by stomatitis. Bismuth and mercury in face creams[1] may produce a brownish-gray or slate-colored discoloration of the skin of the eyelids, nasolabial folds, chin and neck. Goeckerman has demonstrated such pigment histologically and has recommended local applications of $\frac{1}{2}$ to 1 per cent solution of potassium cyanide and the administration of sodium thiosulphate orally and intravenously.

CAROTINOID PIGMENTATION

This is a yellowish discoloration of the skin due to the presence of carotin derived from the ingestion of excessive quantities of carrots, oranges, squash, and some other vegetables. The color is most noticeable on the palms and soles and in the nasolabial grooves; the affection simulates icterus, but does not involve the sclerae or give rise to any symptoms, disappearing when the diet is corrected.

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[1] Hollander, L., and Baer, H. L.: Discoloration of the Skin Due to Mercury, Arch. Dermat. and Syph., 20: 27–35, July, 1929.

ALBINISM

Synonyms.—Congenital achromia, albinoism.

Albinism is a condition characterized by congenital absence of pigment from the skin, hair, and eyes. The condition has a familial or hereditary tendency, and may be partial or complete. It is more common in those who have dark skins, especially in the natives of tropical countries. Other congenital anomalies sometimes accompany albinism, and as a rule the subjects lack resistance to tuberculosis and other diseases. Albinos are hypersensitive to light and suffer intensely from exposure to the sun. Subjects for study may be seen in circus troupes and are characterized by delicate, thin pinkish skin, silky white hair, and pink eyes. Treatment is without benefit.

LEUKODERMA

Synonyms.—Vitiligo, achromia, piebald skin.

This is an acquired pigmentary alteration in the skin which manifests itself by the occurrence of white patches surrounded by normal or increased pigmentation. The patches are of various sizes, irregularly oval, and often symmetrical. In extensive cases they may fuse to form large lobulated white areas and even progress so far that the original complexion is obscured. The affected skin is not changed in any manner except as regards pigment, but the hairs may become white. Ocular depigmentation accompanying vitiligo has been reported by several authors. The whitened patches are hypersensitive to ultraviolet light and burn readily when exposed to the sun. In summer the surrounding skin tans, but the depigmented patches

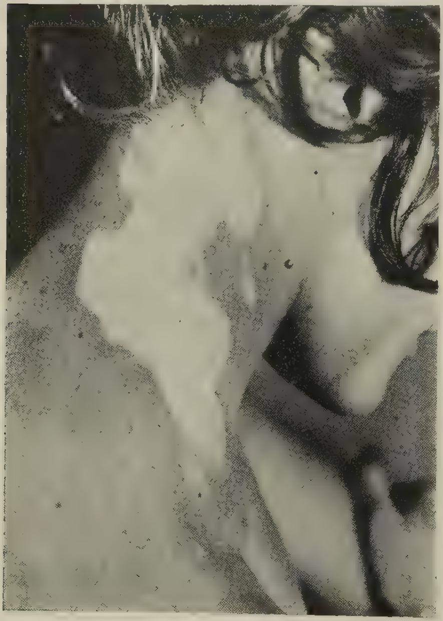

Fig. 945.—Leukoderma.

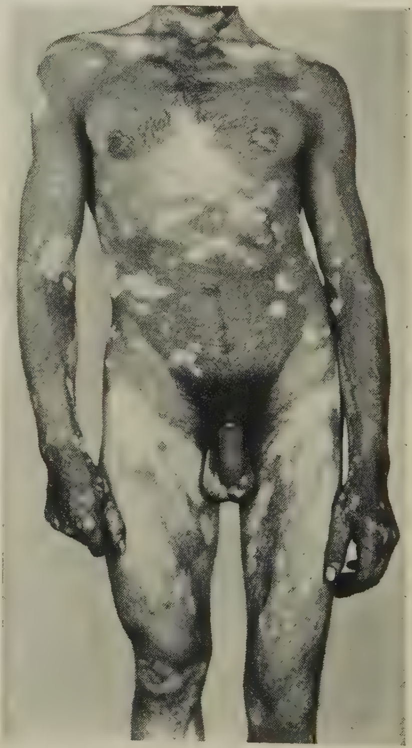

Fig. 946.—Widespread leukoderma in a negro.

exhibit no proliferation of pigment, so that the contrast is exaggerated. The affection may remain stationary for years, but is generally slowly progressive, being influenced deleteriously by sunburn. Leukoderma is more prevalent in the tropics than in cold regions, and affects dark skinned people more than blondes.

The cause of the disorder is unknown. At times there seems to be a familial tendency. It has been suggested that it is a trophoneurosis, belonging in the category of alopecia areata, or that it is produced by some obscure toxin. In one of my cases there were a stippling of red blood cells and other signs of chronic lead poisoning. Severe sunburn, syphilis, and herpes zoster seem to be predisposing causes.

Leukoderma must be differentiated from morphea, in which condition the skin is ivory colored, shiny, and adherent to underlying parts. Pityriasis versicolor and pinta might lead to confusion, but their identity is easily established by the microscopical finding of the fungi and by slight scaling.

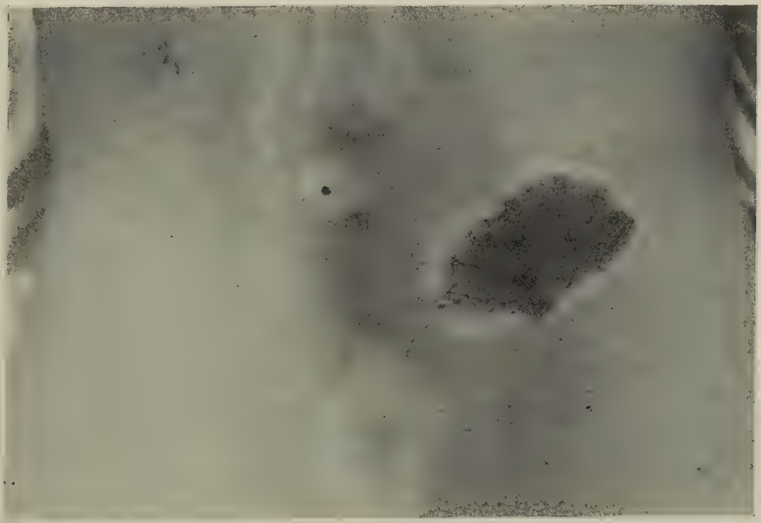

Fig. 947.—Association of leukoderma with pigmented moles (leukoderma acquisitum centrifugum). (Courtesy of Dr. H. W. Barber, London, England.)

No **treatment** has the slightest effect on leukoderma. Small patches on the face may be tinted by the use of stains, vanishing creams, and powder containing pigments. Sometimes the contrast between healthy and whitened patches is lessened by bleaching the normal areas. Formulas for suitable preparations have been given in the treatment of radiodermatitis and acne. Attempts have been made to treat leukoderma by the production of Berlocque dermatitis by the application of a 10 per cent solution of oil of bergamot in alcohol, followed by an exposure to ultraviolet light. Lindsay has reported improvement from intravenous injections of a solution of gold sodium thiosulphate, some cases clearing up entirely after a short series of treatments.

Leukoderma acquisitum centrifugum is a variety of vitiligo, described by Sutton, in which each of the patches is small and rounded and has a brown mole at the center. The condition is fairly common.

ACHROMIA PARASITICA

This affection occurs in the form of dirty white, somewhat pruritic spots, slightly inflammatory in the beginning which, however, soon lose this aspect, becoming slightly scaly and after a while completely devoid of scales. Later in their development they are white spots covered by apparently normal epidermis, simulating leukoderma. The face and neck are the usual locations of the disease, although sometimes it has a generalized distribution. Pardo-Castello and Dominguez, who originally described the affection, reported 36 cases in Cuba, seemingly produced by Aspergillus, which was recovered in pure culture from the areas in 6 patients. There is a tendency for the disease to occur in families, probably being spread by intimate contact.

TATTOO MARKS

Tattooing is an introduction of insoluble pigments into the skin to produce permanent inscriptions and figures. The process is mechanical, the skin being first punctured by means of needles and pointed instruments. These are also used to insert the coloring substances, of which carmine, indigo, vermilion, and Indian ink are the most common. By the use of unclean methods tattooing has been accompanied by inoculation with syphilis and tuberculosis. Occasionally the tattoo marks become keloidal. Drug addicts develop disseminated dark spots due to deposits of carbon from needles sterilized by the flame of a match, which condition resembles tattoo marks because of its development through puncture wounds.

The removal of tattoo marks is invariably unsatisfactory unless they are small and so situated that they can be readily excised.

POWDER STAINS

Discoloration of the skin from embedded powder usually occurs in children from the careless use of firearms or firecrackers. The particles are of various sizes and are deposited at different depths. After a time the connective tissue reaction encapsulates them and may ultimately lead to the formation of keloids.

The best results are obtained in early cases. Light general anesthesia is advisable as the removal is a tedious process, which is best accomplished if the patient is quiet. It is possible to pick out the individual particles by a Hagedorn needle, but my most satisfactory results have been from the use of small skin punches, 1 to 2 mm. in diameter, which cause no scars. The skin is put under tension by the left hand and a punch, the size of the powder particle, is applied over the deposit with the right hand and rotated so that it cuts to the depth of the particle. The core-like bit of skin is then lifted with a small fine pointed forceps and is cut off beneath the powder with small curved scissors. This operation must be done separately to each embedded particle. Any bleeding is controlled by swabbing with pledgets of cotton soaked in adrenalin. After the operation is completed, the area is dressed with sterile paraffined gauze.

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CHAPTER XXXVI

TROPICAL DISEASES OF THE SKIN

YAWS

Synonyms.—Frambesia, boubas, pian, parangi, and other native terms.

Yaws is a contagious systemic disease, caused by the Treponema pertenue, which is endemic in certain tropical regions and is characterized by frambesiform (raspberry-like) skin lesions and by anemia.

Etiology.—The Treponema pertenue is almost identical morphologically with the Treponema pallidum of syphilis, being a slender spiral with eight to ten coils. It has been absolutely differentiated from the syphilitic parasite by inoculation experiments. These have shown that human beings and lower animals infected with one disease do not become immune to the other. In demonstrating the Treponema pertenue, slides for dark-field examination should be prepared from an incised yaw papule before it has ulcerated.

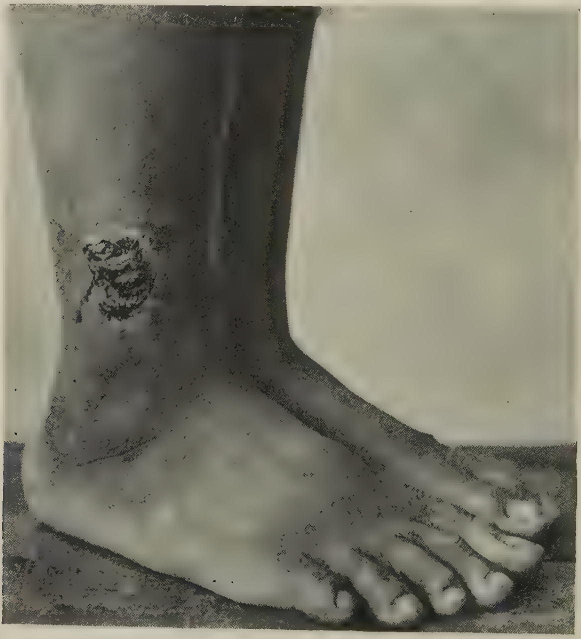

Fig. 948.—Yaws, primary lesion. (Courtesy of Army Medical Museum.)

Filth and overcrowding predispose to yaws, which occurs chiefly in native children of both sexes in regions where it is endemic. A break in the skin seems necessary for transmission, and frequently the disease begins upon preexisting ulcers or abrasions. Later a partial immunity becomes established, which, however, is usually sufficient to prevent second infections. The disease is apparently not transmitted from mother to offspring and is rare in infancy.

Symptomatology.—After an incubation period of three to four weeks during which there are fever, malaise, headache, and vague pains in the joints and muscles, a primary papule, or a group of papules, appears at the site of inoculation. These initial lesions become confluent and larger, and in the course of a few days a yellowish exudate collects, and dries, forming crusts. Later these are picked or knocked off, or fall off spontaneously, and the lesion may heal although more often an ulcer is formed, or a nodule with a granulating surface (mother yaw; maman pian) like the lesions of the secondary or eruptive stage. The "mother yaw" is somewhat painful and is accompanied by regional adenopathy, but is not indurated. Exposed parts are the most frequently involved—the extremities, particularly the lower leg and face—although in mothers the breasts and trunk may be infected by their children. The lesion is practically always extragenital.

The secondary stage is ushered in by intermittent fever and mild constitutional symptoms, four to six weeks after the primary lesion. The eruption begins with minute reddish papules scattered irregularly in various areas, which come out in crops. Some of these develop into soft, painless nodules with granulating or papillomatous surfaces covered with yellowish exudate or crusts, forming the characteristic raspberry-like lesions which are 1 or 2 cm. in width and are distributed chiefly on the extremities and face. An adherent crust surmounts most of the yaws, and when removed leaves a red pulpy mass that exudes serum which dries to form another crust. In some sites, especially around the body orifices, the lesions may flow together and form rings (ringworm yaws), and in the groins, armpits, and gluteal crease condylomatous lesions may arise. On the dorsa of the feet verrucous changes are common. On the palms and soles pigmented spots or nodules are encountered, but more important, there are painful ulcers. These cause a crab-like gait, for which reason they are called "crab yaws." In the late stages a diffuse palmar and plantar hyperkeratosis may occur with unusual pitted depressions, and hard papules with central epidermic plugs, which leave depressions when they are picked out. The subjective symptoms are usually

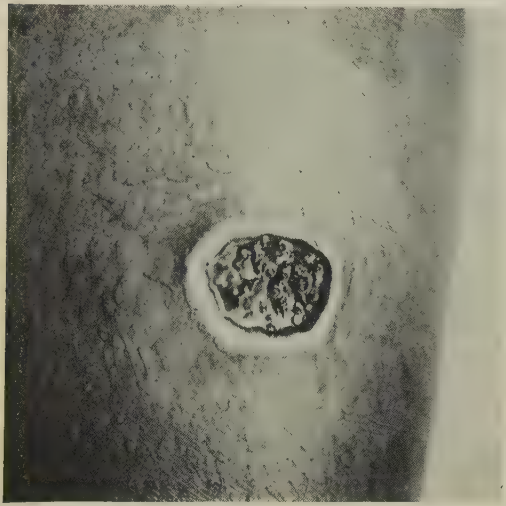
Fig. 949.—Yaws. Primary lesion on leg, close-up view. (Courtesy of Dr. Linus H. Bittner.)

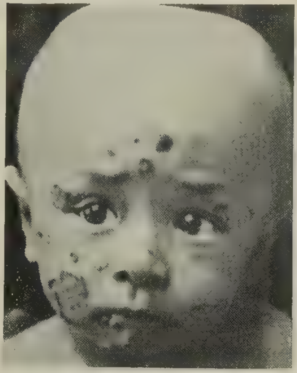
Fig. 950.—Yaws in a child. Secondary lesions around the mouth, a common location. (Courtesy of Dr. Linus H. Bittner.)

not severe, although there may be some itching, pain, and a peculiar repugnant odor to the lesions. In the course of a few weeks, the lesions undergo spontaneous involution and leave whitish spots, which later become hyperpigmented, but due to fresh outbreaks the eruption lasts for several months.

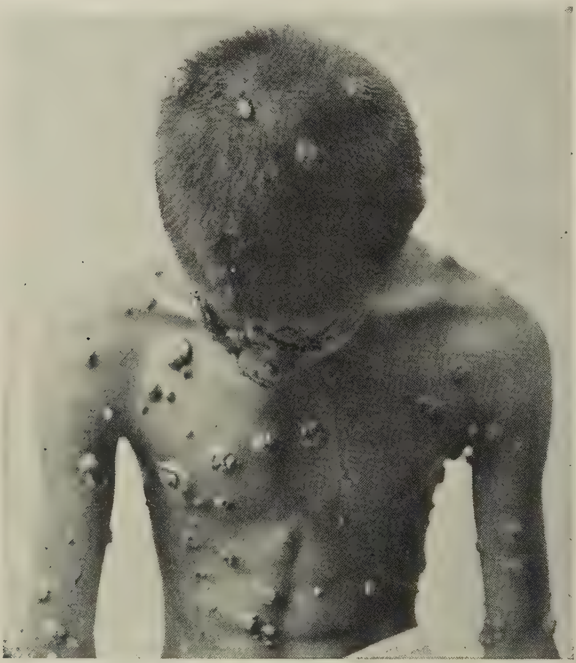

Fig. 951.—Yaws, secondary stage. Note typical raspberry-like lesions. (Courtesy of Army Medical Museum.)

The course is slower in adults than in children, in whom the secondary period rarely lasts longer than six months. In addition to the lesions which have already been described, during the secondary period there are sometimes involvement of the eyelids or of the mucous membranes, although the latter is exceedingly rare, and changes in the nails together with more or less anemia.

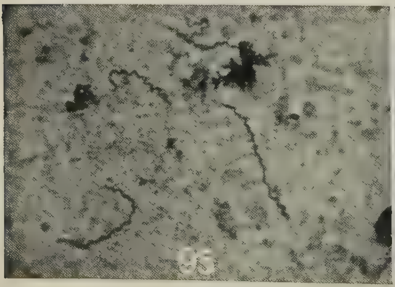

Fig. 952.

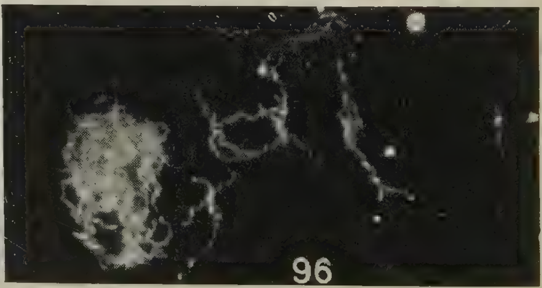

Fig. 953.

Fig. 952.—Treponema pertenue, Giemsa's stain. (After Nichols.)

Fig. 953.—Treponema pertenue; pure culture; dark-field view. (From Hideyo Noguchi, "The Spirochetes" in Jordan and Falk, The Newer Knowledge of Bacteriology and Immunology (1928). Reprinted by permission of The University of Chicago Press.)

The disease usually terminates with the secondary stage, but in some it may progress to the so-called "tertiary stage." In the tertiary stage gummatous lesions occur, producing indolent ulcers with clean-cut or undermined edges, which may fuse to form configurate, and occasionally serpiginous lesions. Upon healing these sores cause considerable scar tissue, which leads to disfigurement. Similar lesions may occur in the osseous system and other deep structures leading to painful nodes in the bones, destruction of the palate, and nasal bones, and to muscular contractures. Whether these lesions of the tertiary stage are or are not due to syphilitic superinfection has been disputed. Those who have studied the disease most believe that tertiary lesions specific of yaws may occur years after the secondary stage.

Gangosa is a mutilating rhinopharyngitis which occurs in the British West Indies and in the Ladrone group, and is endemic in the Island of Guam, and is characterized by progressive ulceration, which usually begins on the soft palate, pillars or uvula and extends to the hard palate, nasal cavity, larynx, and face. The majority of cases occur in pure blooded natives during the second and third decades,[1] and are now generally regarded as a tertiary stage of yaws.

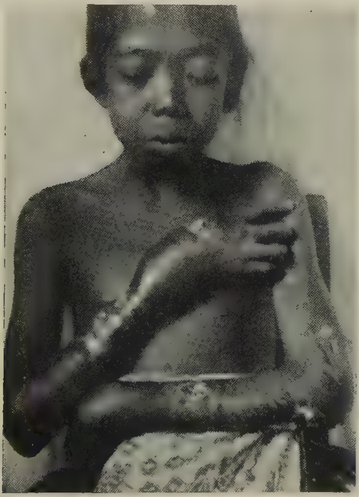

Fig. 954.—Periostitis and gummatous infiltration of arms and forehead in the tertiary stage of yaws. (Courtesy of Dr. Linus H. Bittner.)

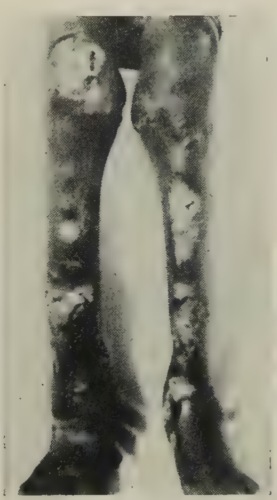

Fig. 955.—Tertiary yaws. Gummatous lesions of legs. (Courtesy of Dr. Linus H. Bittner.)

The affection begins with a slight rise of temperature and the appearance of membranous sore throat followed rapidly by ulceration, which continues with alternate periods of activity and quiescence for several years, associated with a malodorous discharge and the production of cicatrices. In children of gangotic families the process may be fulminating and lead to death, but in other cases it is not fatal and gives rise to no noticeable general symptoms.

Goundou is a peculiar condition encountered in Africa and South America chiefly in the natives, which begins in childhood with bony outgrowths on the sides of the nose, a nasal discharge, and headache. After a few months the discharge and headache disappear, but the tumors continue to grow and ultimately become the size of an orange, leading to great distortion of the features and to destruction of the nose and orbit.

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[1] Mink, O. J., and McLean, N. T.: Gangosa with Additional Notes, J. Cutan. Dis., 25: 503–512, Nov., 1907.

Manson regards the affection as a tertiary manifestation of yaws, stating that goundou cases are immune to further inoculation with Treponema pertenue and that early cases yield to treatment with neoarsphenamine. According to this authority, similar hypertrophic osteitis may coexist or occur separately in other long bones, and there may be periosteitis, particularly of the tibia, epiphysitis, chronic synovitis, juxta-articular nodules, and gummatous skin lesions in the tertiary stage of yaws.

Histopathology.—According to MacLeod, there is first a focal and later a diffuse infiltration in the papillary and subpapillary layer, consisting principally of plasma cells, with some mast cells, connective tissue cells, and small mononuclear cells, and an extravasation of leukocytes which pass from the dilated blood vessels into the tissue spaces and eventually reach the epidermis. In older lesions the infiltration is dense around the blood vessels, follicles, and glands. In the epidermis there are an elongation, and a broadening of the interpapillary processes, but the epidermis over the papillae is not thickened, so that the blood vessels come near the surface and predispose the lesions to ready bleeding. The cornification is imperfect, with the formation of horny masses and crusts composed of imperfectly cornified cells, leukocytic débris, and fibrin. There is no newly formed fibrous tissue such as is found in a syphilide, and the blood vessels in the midst of the infiltrations are unaffected, which are important points of contrast in the pathology of the two diseases.

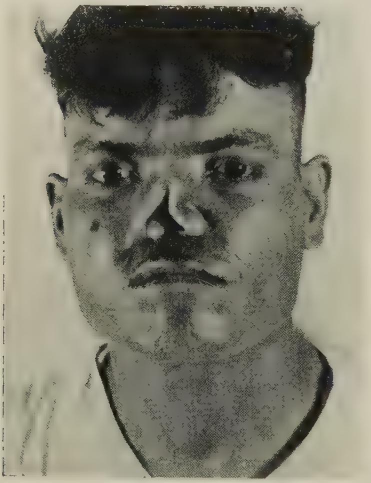

Fig. 956.—Gangosa in a Porto Rican. (Courtesy of Dr. Robert A. Lambert.)

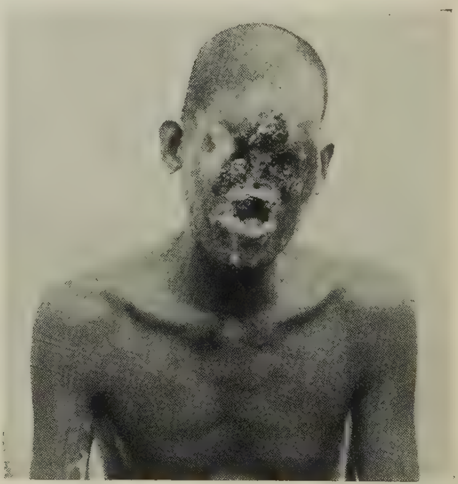

Fig. 957.—Gangosa. (Courtesy of Dr. Linus H. Bittner.)

Yaws must be differentiated chiefly from syphilis. The distinctive features of the disease are the soft painless granulomatous, nodular, excrescences covered by yellowish crusts, nearly always extragenital; the rarity of involvement of the mucous membranes, and the mild degree of lymphadenopathy. The eruption in yaws is of a uniform character although the individual lesions may be in different developmental phases, whereas in syphilis the eruption is usually polymorphous. The serum in both diseases gives a positive Wassermann reaction. Syphilis may be hereditary, while yaws is not. The occurrence of the latter disease is practically limited to the tropics.

Prognosis.—The disease seems to wear out in the course of months or years and is rarely fatal. One attack confers immunity which generally protects against future invasions. The anemia and weakness caused by the long duration and the amount of toxic absorption are the chief after-effects.

Treatment.—Treatment is by the use of arsphenamine, as given in syphilis. This drug is far more effective in yaws than in syphilis. Frequently one injection causes the disappearance of all lesions, but the administration must be continued until the serology is negative. According to Manson, the average time to effect a cure is given as eleven days. Castellani recommends potassium iodide. Intramuscular injections of bismuth are effectual. Apparently mercury has little beneficial action.

Locally the lesions should be treated by antiseptic wet dressings and powders. An attempt should be made to improve the general health by appropriate tonics, food, and hygiene.

AINHUM

Synonyms.—Dactylolysis spontanea, Banko-kerendé, sukha-pakla, and other native terms.

Ainhum is an affection of the toes, especially the little one, and sometimes of the fingers, characterized by a linear constriction which leads ultimately to the spontaneous amputation of the part. It occurs chiefly among the adult male negroes of certain tropical regions. The disease begins with a transverse groove in the skin on the flexor surface of the little toe, usually beneath the first interphalangeal articulation. The furrow is produced by a ringlike fibrosis and an induration of the corium. It deepens and extends laterally around the toe until the two ends meet, so that the digit becomes constricted as if in a ligature. The constricted part becomes swollen and soft and after a time greatly distended. Ulceration may supervene and result in a malodorous discharge, with pain and gangrene. The course of the disease is slow, but in five to ten years spontaneous amputation occurs, generally through an articulation. The etiology is unknown. Possibly it is a parasitic infection, as the natives go barefoot, but it may be a trophoneurosis associated with sclerodermia or leprosy, or a familial malformation.

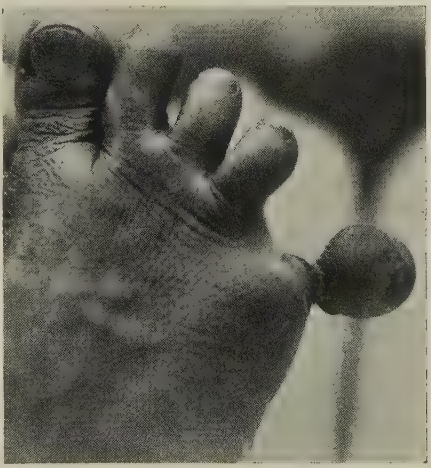

Fig. 958.—Ainhum, showing the disease at its height, but no gangrene. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

Treatment in the early cases is by cutting the constricting band, which may stop the process; but in advanced cases amputation of the affected member is advisable.

TROPICAL ULCERS

Synonyms.—Tropical phagedena, Aden ulcer, Malabar ulcer. Also various native terms.

Under the term "tropical ulcer" a variety of skin conditions have been described. Many of these have been due to syphilis or yaws or to the infection of abrasions by pyogenic organisms. Vincent has demonstrated the fusiform bacillus and the spirillum, better known in connection with Vincent's angina, in smears from tropical ulcers, and in other lesions spirochetes of various forms have been found. Whether these have been pathogenic or saprophytic is a matter of conjecture. The occurrence of the ulcers chiefly during the damp months, beginning in May and increasing during August, September, and October, and their frequency among the barefooted and debilitated point to an infectious origin. The condition is most common in native laborers and in school children during the rainy season, and is probably transmitted by the bites of insects.

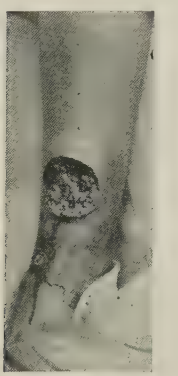

Fig. 959.—Ulcus tropicum, discharging lesion, 8 cm. in diameter. (Courtesy of Dr. Teofilo Corpus, Malolos, P. I.)

The disease occurs on exposed parts of the body, chiefly the legs and arms, frequently on pre-existing abrasions or sores, sometimes beginning from a mere scratch. The sites of predilection are the anterior and posterior portions of the legs, and the dorsal part of the feet, and the ankles, the anterior portion of the lower leg being most frequently involved. As a rule only one extremity is affected and usually there is a single lesion, although it is not uncommon to find multiple ulcers upon both legs, rarely more than three in number. Satellite lesions ordinarily occur due to auto-inoculation. The lesions begin with inflammatory papules which progress into vesicles and rupture with the formation of an ulcer. The ulcers vary in diameter from a few millimeters to several centimeters and may through coalescence form extensive lesions. They are usually round or oval. The lesions of some varieties are elevated or deeply depressed and generally the edges are undermined, being smooth or ragged. At times the ulcers are covered by thick, dirty crusts or by whitish pseudomembranes. The edges are flat, without thickening, and around them there is a zone of inflammation characterized by redness, swelling, and some tenderness. Aside from this symptom and slight itching, the lesions otherwise cause no distress.

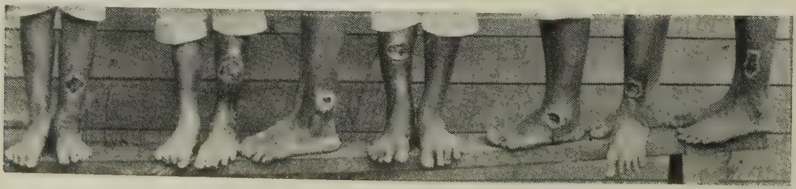

Fig. 960.—Tropical ulcers in native children. (Courtesy of Dr. Teofilo Corpus, Malolos, P. I.)

Treatment.—Prevention of the disease is possible by protection from insect bites and from predisposing causes, such as debility and filth. A diet containing a high proportion of vitamins, and quinine are indicated. The local ulcer should be painted with formalin or widely removed by the actual cautery, and dressed with solution of bichloride of mercury, 1 : 1000, or with ammoniated mercury ointment. Corpus recommends local applications of 3 per cent solution of arsphenamine or of Vincent's powder composed of one part sodium hypochlorite and nine parts boric acid. Manson recommends the trial of x-ray therapy whenever it is available.

BARCOO ROT

Synonyms.—Veldt sore, desert sore.

This is an ulcerative disease which is endemic in Australia among bushmen and soldiers. A similar affection has been encountered in Africa, being called the Veldt sore. The disease is characterized by the occurrence of a group of pruritic vesicles on the extremities, chiefly on the backs of the hands, which rupture and form superficial indolent ulcers. The Bacillus diphtheriae has been demonstrated in some cases, and at times there are coexistent diphtheritic paralyses.

Treatment is by epilation of the hairs in the affected area and by the application of 2 per cent formalin solution or ammoniated mercury ointment. Antidiphtheritic serum should be injected in a dose of at least 4000 units, in the neighborhood of the sores, in cases due to the Klebs-Löffler bacillus.

ORIENTAL SORE

Synonyms.—Oriental boil, leishmaniasis, Biskra button, Delhi boil, Delhi sore, Aleppo boil, Kandahar sore, Lahore sore.

Oriental sore is a granulomatous disease produced by the Leishmania tropica (Wright), which is characterized by the occurrence of indolent, indurated, and slowly progressive ulcerations upon exposed parts of the body, in certain tropical countries. The lesions may be single or multiple and not infrequently are located near one another and coalesce to form a large patch. At the beginning there are one or more erythematous shotty papules which in a few weeks become crusted and exude a yellowish discharge. Beneath the crust there is an ulcer, which may be crateriform. The base is covered by granulations and about the lesion there is considerable inflammatory reaction. Ulcerations may grow to be several centimeters in diameter, but usually after a number of months spontaneous healing occurs, with the formation of a cicatrix. Occasionally, the lesions involute prior to ulceration. When the face is involved, the features may become distorted from the scar formation.

Occasionally Oriental sore does not ulcerate, but remains an indurated scaly plaque. A widespread nonulcerating form, called *dermal leishmanoid*, has been described. The lesions are nodular and have a predilection for the face and upper extremities. Manson states that some cases have occurred as a sequel to kala-azar, and others have been mistaken for tubercular leprosy.

Etiology.—The Leishmania tropica is a round or ovoid parasite which is about 2 to 3 μ in cross section and which may be demonstrated in smears from the lesions, being found in the cytoplasm of the cells. It is morphologically indistinguishable from the bodies found in kala-azar, but these diseases are usually considered separate entities. The affection is transmissible by direct or indirect contact and is auto-inoculable. The incubation period varies from a few weeks to several months. Not infrequently children are affected; they seem to acquire a certain degree of immunity which protects them from future attacks.

Histologically, there is a spheroid cellular infiltration which extends deep into the corium and is composed of plasma cells, lymphocytes, endothelial cells, and polymorphonuclear leukocytes.

Diagnosis.—In Asia Minor, India, Northern Africa, and Tropical South America where the disease is endemic, the diagnosis is not attended with any difficulty, but in other localities Oriental sore may be confused with syphilis, yaws, lupus vulgaris, and a granuloma due to pyogenic cocci. The diagnosis is established by the demonstration of the Leishmania tropica. By employing injections of an alkaline extract of the parasite, Montenegro secured positive skin reactions which he considers specific, occurring in 86½ per cent of cases.

Treatment.—The affection is refractory to treatment. Early lesions may be removed by the actual cautery or may be excised. Good results have been reported from intensive exposures of the affected area to x-rays. It is asserted that a single erythema dose of x-rays produces a cure within ten days in the majority of cases. Tartar emetic given intravenously in a 2 to 4 per cent solution is highly recommended, with initial doses of ½ grain. The injections are given twice weekly—a total of 10 to 15 grains of antimony tartrate usually being sufficient to effect a cure.[1]

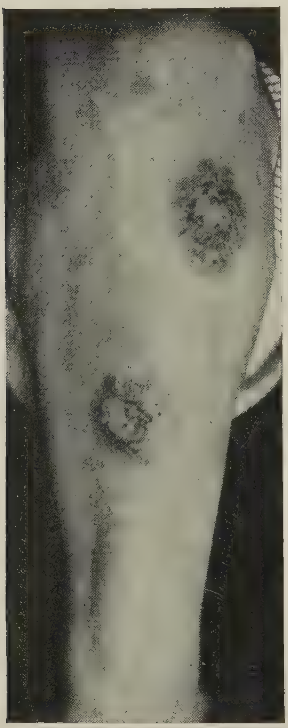

Fig. 961.—Oriental sores on arm, showing typical crateriform appearance. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

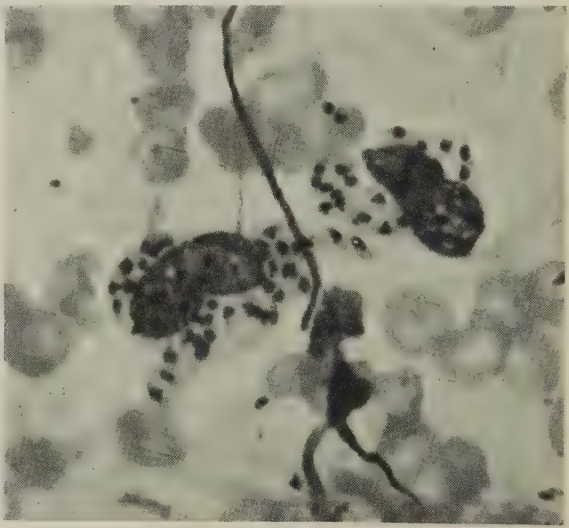

Fig. 962.—Leishmania tropica. Smear from Oriental sore. Giemsa's stain. Parasites containing a nucleus and a rod-like paranucleus grouped in large phagocytic cells. The strand across the field is fibrin. Oil immersion lens. (Courtesy of Dr. Lewis B. Robinson.)

AMERICAN LEISHMANIASIS

Synonyms.—Uta, espundia.

Throughout Central and South America there is endemic a disease caused by a leishmania which is different from Oriental boil, although the latter is encountered sporadically, especially in Argentina, attacking the Asiatic immigrants who have brought it from the Far East. American leishmaniasis manifests itself upon either the skin or mucous membranes, but is essentially a blood disease, like syphilis, and is obstinate and of long duration. American leishmaniasis is a progressive disease which produces granulomatous nodules and destructive ulcers chiefly in the mouth and nose. The skin lesions may be papular or tubercular and are usually ulcerated or crusted. They may be associated with atrophy or lymphangitis. At the site of inoculation there develops a primary sore or chancre and this is followed by secondary and tertiary symptoms. Two varieties of the disease are recognized—*uta*, in which the skin is the part affected and in which the disease extends peripherally from the chancre without any breach of continuity; and *espundia*, in which the disease first attacks the skin and then spreads to the mucous membranes and in which there is an interruption of continuity between the initial chancre and the secondary and tertiary lesionss. These appear after a variable period, which is sometimes very long, and tend to have a definite localization and mode of evolution and to follow a course that is the same in the majority of cases. Apparently the disease extends from the skin to the site of the secondary and tertiary lesions by way of the circulation.[1]

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[1] Manson: Tropical Diseases, 1929, p. 158.

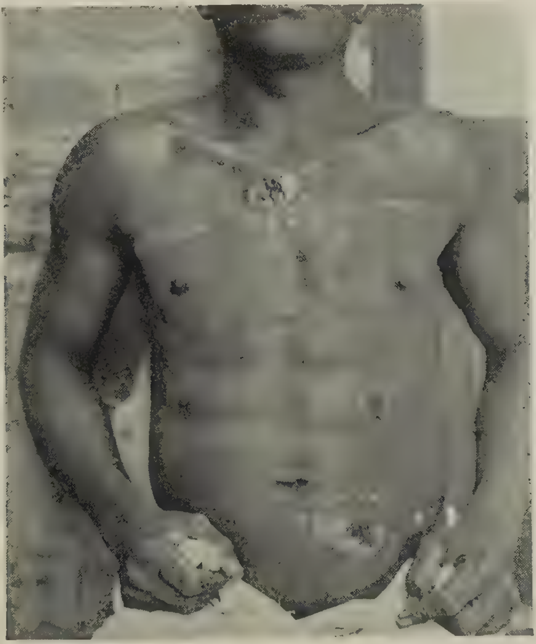

Fig. 963.—American leishmaniasis, primary lesion. (Courtesy of Dr. Robert A. Lambert.)

Espundia begins with a primary lesion in some exposed portion of the body. This is an ulcer, with thickened edges and a granulating base, being called the "espundic chancre," which in many respects resembles the Oriental boil. After months this sore heals; nodules and ulcers appear then or later in the nasopharynx. These progress slowly with severe destruction and mutilating scarring until death occurs from sepsis and malnutrition due to interference with deglutition, unless tartar emetic treatment is instituted. The favored site of the secondary lesions is on the mucous membranes of the upper respiratory and digestive tracts extending from the nares to the trachea and sometimes from the lips to the esophagus. In some cases of palatal ulcer two deep furrows are produced, one along the edge of the soft palate and the other crosswise to it in the median palatal line, forming a sign which is known as the "palatal cross of espundia." After several years, even after twenty years, symptoms of decline and cachexia may appear.

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[1] Escomel, E.: Leishmanosis Americana y las Leishmanosis en America, Rev. med-Panamericana, 4: 189–199, Apr., 1929.

There are localities of high altitude where uta predominates and in other regions the two forms are mingled but each retains its identity. Unlike Oriental boil, uta and espundia mutilate the countenance and do not confer immunity.

Etiology.—The causative organism was first demonstrated by Miranda, and is a variant of Leishmania tropica, the etiologic agent in Oriental sore. This may be easily discerned in smears made from the discharge or from juice expressed from bits of tissue.

Diagnosis.—American leishmaniasis may be confused with blastomycosis, facial lupus, nasal syphilis, gangosa, glanders, rhinoscleroma, nasal myiasis, and venereal granuloma. The differential diagnosis must often be established by laboratory examinations. Blastomycosis does not respond to treatment by tartar emetic. In glanders the occupation of the patient, the presence of specific bacilli, and the experimental orchitis of Straus are of diagnostic value. In rhinoscleroma the causative bacillus may be demonstrated and in nasal myiasis the larvae are evacuated following inhalations of the fresh plant *Ocimum basilicum.*

Treatment.—This is both local and general. The chancre should be removed with a cautery or excised widely—at least 1 cm. beyond the lesion into the healthy skin. It may also be treated by local injections of hypochlorite of calcium, of glycerite of phenol; or by sprinkling with tartar emetic. The object of the local treatment is to cause the rapid destruction of all tissue suspected of being infected.

Internally a series of intravenous injections of 1 per cent solution of tartar emetic should first be given. If tolerated, the injections should be given daily, but otherwise at the rate of three a week up to a total of ten injections. After this course, there should be given ten intramuscular injections of iodine bismuthate of quinine three times a week. After this series, the tartar emetic injections should be repeated and thereafter weekly injections of iodine bismuthate of quinine should be given for six months after the cure of the chancre. Throughout his life the patient should consult a physician at the first appearance of symptoms connected with his nasal, pharyngeal, buccal, or laryngeal cavities.

The intranasal manifestations are treated by means of alkaline washes to soften and to dislodge the mucus and crusts and by applications of caustics such as trichloracetic acid, or phenol. Local treatment should be accompanied by intravenous injections of tartar emetic, alternating with intramuscular injections of iodine bismuthate of quinine until long after complete cicatrization of the lesions has occurred.

ELEPHANTIASIS

Synonyms.—Pachydermia, elephant leg, and numerous other kinds of leg; elephantiasis Arabum, elephantiasis indica, *et cetera.*

Elephantiasis is a widespread tropical disorder characterized by lymphedema, with resulting hypertrophy of the skin and subcutaneous tissues, and by enlargement and deformity of the affected parts, usually the legs or scrotum. The disease occurs more frequently in males than in females. Most of the endemic cases are due to filarial infection, which is transmitted by the bites of mosquitos. Sporadic cases, especially those in temperate climates, are caused chiefly by chronic streptococcic infection. Although clinically simulating the filarial disease which is true elephantiasis, chronic streptococcic lymphedema (elephantiasis nostras, p. 534) is a distinct entity etiologically and therapeutically. The term "elephantiasis" is also applied in a solely descriptive and casual way to hypertrophy and thickening of the tissues from any cause.

The onset of true elephantiasis is due to the filaria, and is characterized by recurrent attacks of acute lymphangitis in the affected part, associated with chills and fever (elephantoid fever), which last for several months. After each attack the swelling only partially subsides, and as recrudescences supervene, thickening and hypertrophy become increasingly pronounced. The overlying epidermis becomes stretched, thin, and shiny, and, in the course of years, leathery, insensible, and verrucous or papillomatous from secondary pyogenic infection.

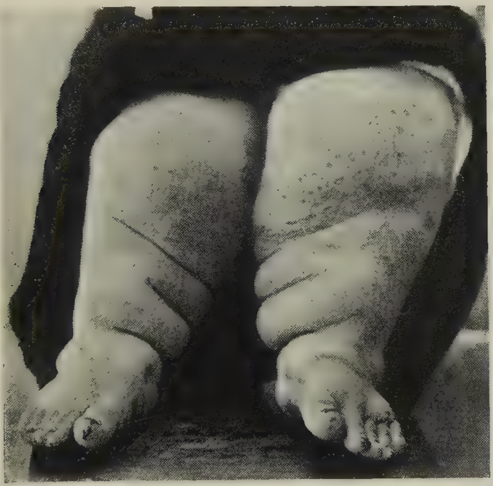

Fig. 964.—Elephantiasis. (Courtesy of Dr. Bailey K. Ashford, Porto Rico.)

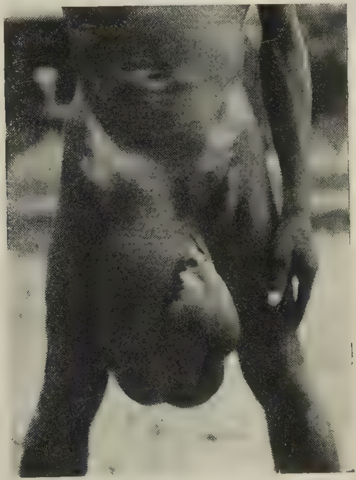

Fig. 965.—Elephantiasis of scrotum and hyperplastic inguinal glands in a Porto Rican. (Courtesy of Dr. Bailey K. Ashford, Porto Rico.)

In addition to the involvement of the legs and scrotum, the scalp, vulva, female breasts, and arms are at times affected, either alone or in association with the other regions. The manifestations vary according to the part involved. When the legs are attacked, they are both usually affected in a somewhat symmetrical manner, the principal changes occurring on the posterior aspects above the ankles and on the dorsa of the feet. At first the thickening may be slight and associated with an edema which pits on pressure. Later the parts become massive and pachydermatous, the thickened integument hanging in apposing folds, between which there is a fetid exudate. Due to the impaired resistance of the tissues traumatic ulceration, and secondary infection with cocci are common. When the scrotum is affected it gradually reaches an enormous size and the penis becomes hidden in it. The skin which at first is glazed, later is coarse and verrucous, or in the far advanced cases, ulcerated or gangrenous.

Microscopically, the lymphatic vessels are widely dilated and there is a proliferation of connective tissue. About the vessels there are collections of lymphocytes and fibroblasts. Examination of the blood reveals a leukocytosis and eosinophilia, more pronounced when there is fever. In early cases filaria may be found in the blood at night, but during the day these parasites remain in the capillaries of the lungs, so that they are not visible.

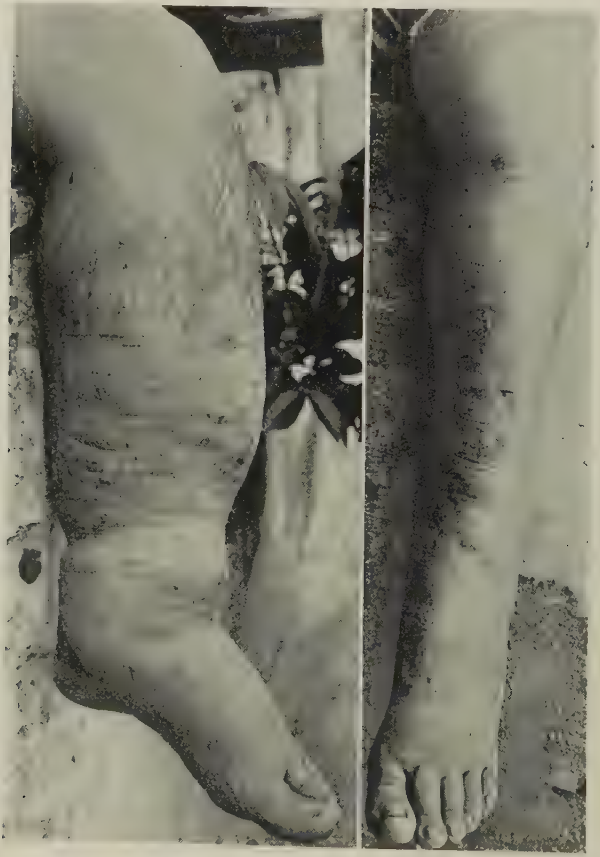

Fig. 966. Fig. 967.

Figs. 966, 967.—Elephantiasis. Before and after excision of wedge-shaped strips of tissue. (Courtesy of Dr. Bailey K. Ashford, Porto Rico.)

Diagnosis.—The diagnosis is usually not difficult, although it is generally impossible to demonstrate the filaria. In sporadic cases confusion may exist between true elephantiasis and elephantiasis nostras, but the latter is most frequent on the face and is associated with recurrent attacks of erysipelas. Lymphedema due to syphilis or obstruction of the lymphatics by neoplasms must always be excluded.

The prognosis in regard to life is good, but living becomes burdensome unless the condition is alleviated.

Treatment.—There is no specific remedy, and the affection must be treated symptomatically in a manner similar to that used for lymphangitis and edema. The chief forms of relief are surgical, generally by supportive elastic bandages, the excision of wedge-shaped pieces of tissue and closure, or by amputation. Prophylactic measures consist in protection from mosquito bites by appropriate nets and by destruction of the insects.

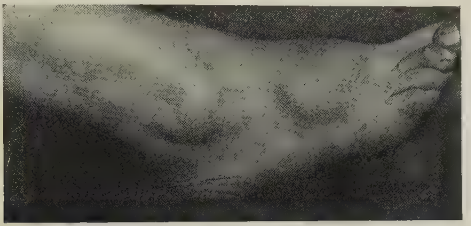

Fig. 968.—Early elephantiasis. Swelling on dorsum of foot. (Courtesy of Dr. Robert A. Lambert.)

Calabar Swelling (*Tropical Swelling*).—This affection occurs in natives and Europeans alike in tropical West Africa and is characterized by one or more slightly inflamed, localized swellings, a couple of centimeters wide and a half centimeter or so high, situated chiefly on the extremities and due to infestation of the subcutaneous tissue with the Filaria loa. The swellings are more or less evanescent, appearing suddenly, lasting a few hours or days and gradually disappearing. Headache and eosinophilia are frequently present. The course varies, sometimes lasting a few months and in other instances continuing indefinitely in spite of a change of climate. The microfilaria has been demonstrated in the lymph from the swellings. Treatment is by determining the location of the worm and its extraction, or destruction by injections of bichloride of mercury about it.

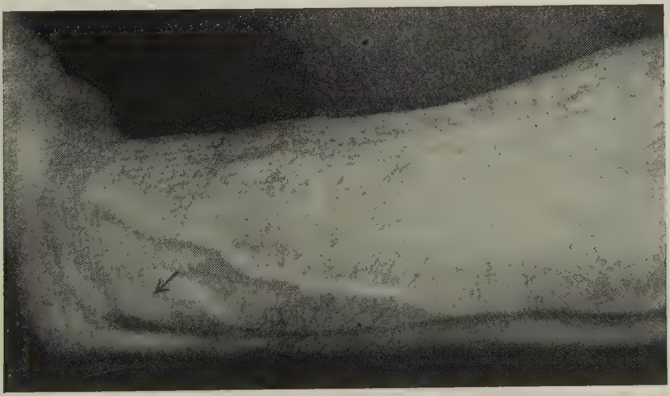

Fig. 969.—Cystic swelling on anterior aspect of wrist produced by Filaria loa. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

Human Trypanosomiasis.—According to Manson-Bahr, one of the remarkable features of human, as well as animal, trypanosomaniasis, is the tendency to skin eruptions and local edemas. The eruptions are apparently more pronounced in the earlier stages of the disease and consist of evanescent erythemas of the erythema multiforme type, sometimes annular or sometimes resembling erythema nodosum. In negroes an itching papular eruption is a common symptom. Circumscribed swellings of the nature of angioneurotic edema are frequently encountered, and in the South American type of the disease a puffiness of the face, accompanied by conjunctivitis, is said to be so characteristic as to be almost diagnostic of the disease.

VERRUCA PERUVIANA

Synonyms.—Verruca peruana, Carrion's disease, Peruvian wart, Oroya fever.

This infectious constitutional disease is endemic in certain valleys in the central part of Peru and is characterized by anemia, rheumatoid pain, asthenia, and fever, and terminates in many cases in a peculiar papillomatous skin eruption. After an incubation period of from sixteen to twenty-one days, there begins the pre-eruptive period, in which the Bartonella bacilliformis is abundant in the circulating blood. This stage is characterized by general debility, moderate, intermittent afternoon fever, progressive anemia, and rheumatoid pains. There are an enlargement of the spleen and lymph glands, and a diminution in the coagulability of the blood, which is evidenced by a tendency to petechiae and to nosebleed. There is a leukocytosis with a relative increase of polynuclear cells. This period usually lasts about two weeks and then the disease either produces general prostration with unconsciousness due to loss of blood, and fever and ends fatally; or it progresses into the eruptive period, during which the symptoms abate, the fever subsides, and the parasites disappear from the blood stream, becoming localized at the site of the skin manifestations.

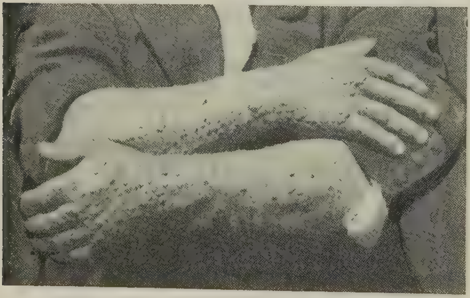

Fig. 970.—Verruca peruviana, miliary lesions. (Courtesy of Dr. Richard P. Strong.)

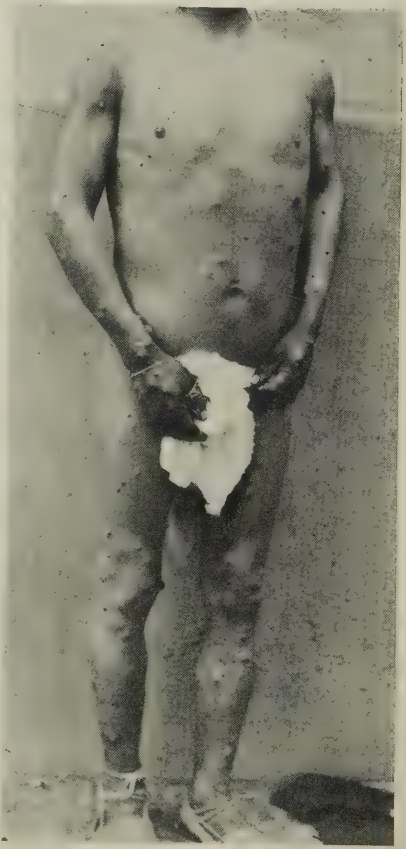

Fig. 971.—Verruca peruviana, showing general distribution of nodular lesions. (Courtesy of Dr. Richard P. Strong.)

Three varieties of cutaneous lesions are recognized: the verruca miliar (very small); the verruca nodular (subcutaneous and large); and the verruca mulár (gigantic). The three varieties may occur in the same patient, and the lesions may be discrete or confluent. The verruca miliar looks like a little cherry. These lesions begin in the form of little button-like erythematous spots, which are more discernible to palpation than to vision. The lesions may be sessile or pedunculated, with smooth or corrugated surfaces, and sometimes they are multilobular.

The verruca nodular begins in the subcutaneous tissue and grows to the point where it feels like a button. After several days it stretches the skin overlying it and shows as an ovoid growth with a diameter of 1 to 2 cm.

The verruca mular is a development of the verruca nodular, is almost always associated with ulceration of the overlying skin; and has the appearance of an irregularly lobulated, highly vascular tumor. The eruption may recur in crops in a mild way over long periods or there may be a severe relapse, with fever and a fatal outcome. The lesions are highly vascularized and are composed microscopically of dense cellular infiltration consisting of endothelial cells, plasma cells, and leukocytes.

Etiology.—A coccoid parasite has been demonstrated in the blood stream during the pre-eruptive period and in the endothelial cells of the verrucous tumors and is believed to be the specific causal agent. Strong gave it the name Bartonella bacilliformis (also called Bartonella peruviana). By experimental inoculation in man and animals the disease has been reproduced in its two phases, separately or successively, with bartonella taken directly from the blood of patients or from their skin nodules, or from cultures.

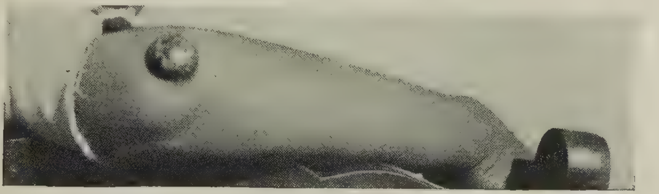

Fig. 972.—Verruca peruviana. Advanced mulare lesion. (Courtesy of Dr. Richard P. Strong.)

Diagnosis.—In the pre-eruptive stage the diagnosis is established by the combination of fever, anemia, asthenia, joint pains, adenopathy, and the presence of the parasites in the blood. In the eruptive stage the manifestations are typical, and if once seen cannot be mistaken for any other eruption.

Treatment.—No specific treatment has yet been discovered, so that therapeutic measures are largely based upon the symptomatology. Mercurochrome-220 soluble has been used intravenously with doubtful results.[1]

GUINEA-WORM DISEASE

Synonyms.—Dracontiasis, Guinea worm, Medina worm, Dracunculus medinensis, Dracunculosis.

Guinea-worm disease is endemic in many tropical districts, due to infection with a nematode worm of the genus Dracunculus, through the medium of contaminated drinking water, in which they are parasitic on a small crustacean. In the stomach, the larvae leave their former host and penetrate into the mesentery where they mature in the course of a year. Then the female worm burrows to the cutaneous surface in order to deposit her larvae, and thus causes the specific skin manifestations. As the worm approaches the surface it may be felt as a cord-like thickening and elevation of the epidermis; but the lesion rapidly becomes a vesicle which bursts and leaves an ulcer. At the bottom of this is an opening, the size of a pinhole, in which the vaginal end of the worm may be seen, while in the exudate from the ulcer larvae are present. These ulcerations may be single or multiple, usually the latter, and on any part of the body, although the usual sites are the legs and feet. In addition to these lesions the invasion of the parasites may cause pain, and toxic symptoms consisting of fever, eosinophilia, and urticaria.

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[1] Escomel, Ednumoto: La Euprmedad de Carrion o Verruga Peruana, Revista Mediae Panamericana, 4: 87–100, 1929. (The author is indebted to this article for most of the material on this disease.)

Treatment.—The disease may be prevented by boiling the drinking water. Native treatment consists of gradually extracting the worm a little each day, with care not to rupture it, for in the event of such an accident the larvae escape into the tissues and produce fulminating inflammation. An aqueous solution of mercury bichloride, 1 : 1000, may be injected into the worm or into the lesion caused by it, and generally upon the following day the parasite can be readily extracted.

GRANULOMA INGUINALE

Synonyms.—Ulcerating granuloma of the pudenda, granuloma inguinale tropicum, groin ulceration.

This is a contagious chronic, locally destructive disease which is encountered chiefly in negroes, especially women, and is characterized by progressive, indolent, serpiginous ulcerations of the groins, pubes, genitals, and anus. The disease occurs chiefly in the tropics, but is endemic in the southern part of the United States. The early lesions are nodular elevations about which the skin is thickened and hyperemic. These soon become ulcerated, and by the development of satellite lesions through auto-inoculation and peripheral extension, and by gradual undermining of sound tissue at the growing edge, the lesion enlarges. The floor of the ulcer may be covered with dirty gray material and its walls may be overhanging, or due to the growth of vegetations a papillomatous fungating mass may be formed. Usually there are a malodorous discharge, and disfigurement due to contracting bands of scar tissue, among which multiple sinuses may persist for years. The regional lymph glands are usually not enlarged but due to the cicatrices there may be ob-

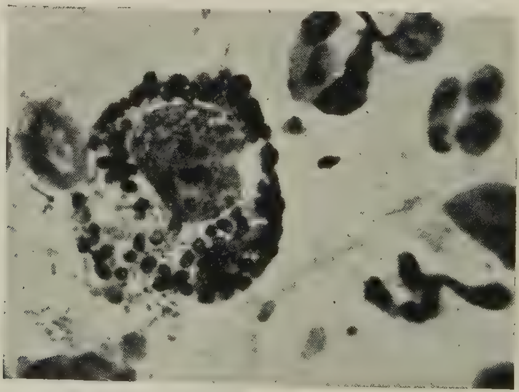

Fig. 973.—Donovan bodies from a case of granuloma inguinale. (Courtesy of Dr. J. Gardner Hopkins.)

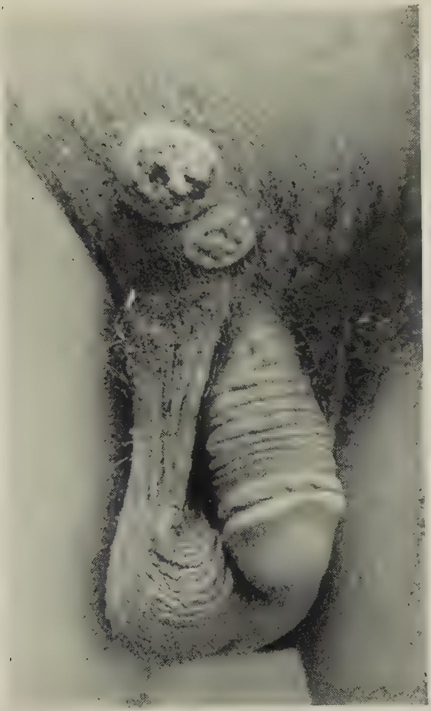

Fig. 974.—Granuloma inguinale, early lesions. (Courtesy of Dr. Robert A. Lambert.)

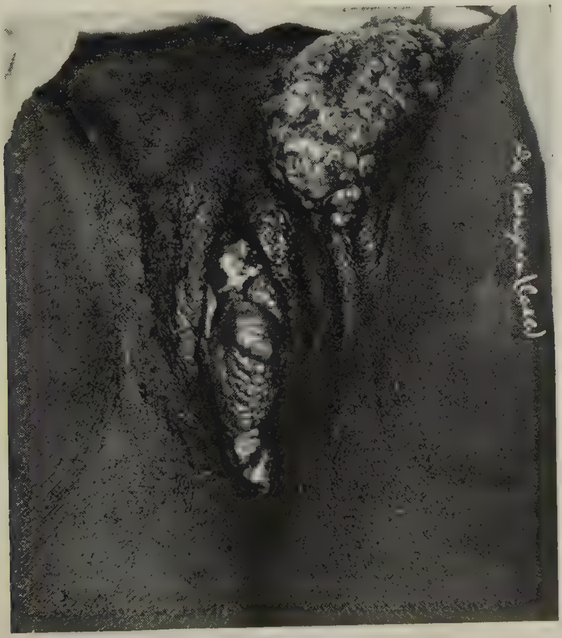

Fig. 975.—Granuloma inguinale (Courtesy of Dr. Mihran B. Parounagian.)

struction of the lymphatics, and localized pseudo-elephantiasis. The lesions are not painful and produce but mild subjective symptoms. At times there is an associated anemia.

Probably granuloma inguinale is usually contracted through sexual intercourse, although the exact mode of infection is undetermined. Those affected are generally young adults. Other regions besides those already mentioned may be involved.

Etiology.—The cause of granuloma inguinale is undetermined, but in smears from the lesions in the cytoplasm of the mononuclear cells there are constantly observed inclusions, called Donovan bodies, thus named after their discoverer. Secondarily, there are often present a short encapsulated bacillus resembling the Bacillus mucosus-capsulatus[1] and other contaminants, including spirochetes. When demonstrated by Wright's stain the Donovan bodies are round or oblong pink structures with a central deep-red chromatin spot. There appears to be a capsule about the cytoplasm, because its edge stains deeply. The bodies occur singly or in groups intracellularly. Smears are best obtained by incising the lesion and scraping its depth.

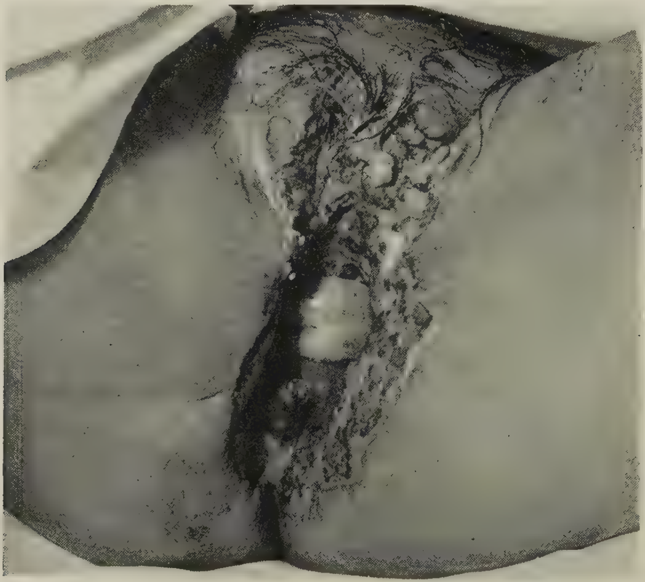

Fig. 976.—Granuloma inguinale, showing extensive ulceration. (Courtesy of Dr. Floyd W. Rice.)

When the Gram stain is used the intracellular organisms stain Gram-negative, whereas those that are extracellular stain Gram-positive. Manson-Bahr and Anderson believe that all these supposedly causal organisms are only contaminants. They also call attention to the similarity and close association between this disease and rhinoscleroma in Sumatra. In the corium there is a dense cellular infiltration composed chiefly of lymphocytes, plasma cells, polymorphonuclear leukocytes, and fibroblasts. There are a degeneration of the connective tissue and a thickening of the epidermis.

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[1] Sage, I. M.: Granuloma Inguinale, Arch. Dermat. and Syph., 19: 764, May, 1929.

Diagnosis.—Granuloma inguinale may be confused with ulcerations of the groin due to syphilis and carcinoma, but is differentiated from these diseases by its long duration and slow course, by the absence of lymphatic involvement, and, in the case of syphilis, also by a negative Wassermann reaction and failure to respond to antiluetic treatment. It is distinguished from the ulcerative type of tuberculosis microscopically by the absence of tubercles and giant cells.

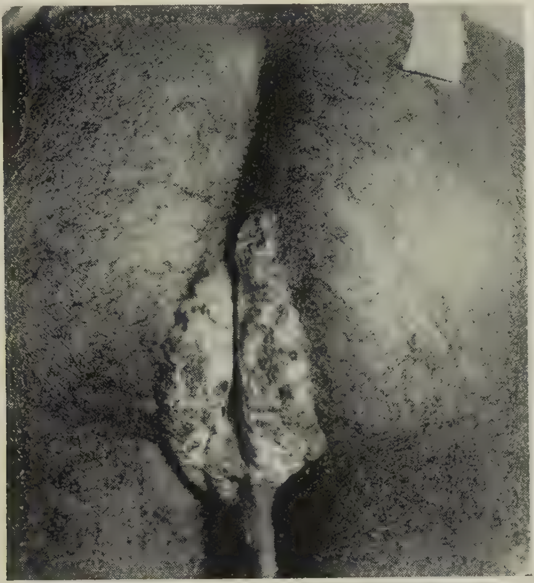

Fig. 977.—Granuloma inguinale, perianal.

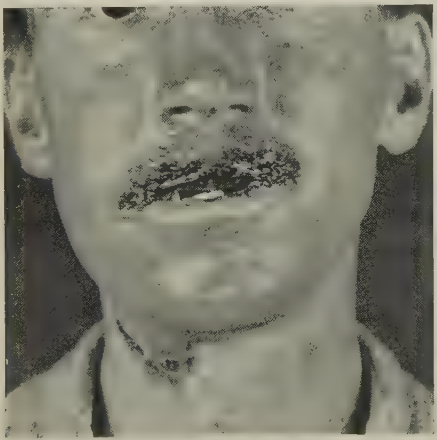

Fig. 978.—Ulcerating granuloma (granuloma inguinale.) (Courtesy of Dr. Mihran B. Parounagian.)

Treatment.—The principal method of treatment is by intravenous injection of 1 per cent solution of tartar emetic, given continuously twice weekly, beginning with 5 cc. and increasing to 10 cc. The amount required for cure varies considerably, being as high as 175 grains of the tartrate. Manson emphasizes that the injections must be given in a continuous series because interruption of the series is followed by extension of the ulcerations. This form of treatment is believed by some to be specific, but in other hands it has proved disappointing. Oleum phosphoratum (B. P.) has been recommended as beneficial. Some advocate the early removal of the affected area by surgical excision or the cautery, because of the recalcitrance of the disease to other methods of treatment. Roentgen therapy has frequently been effectual, but in some cases seems to have no action whatsoever.

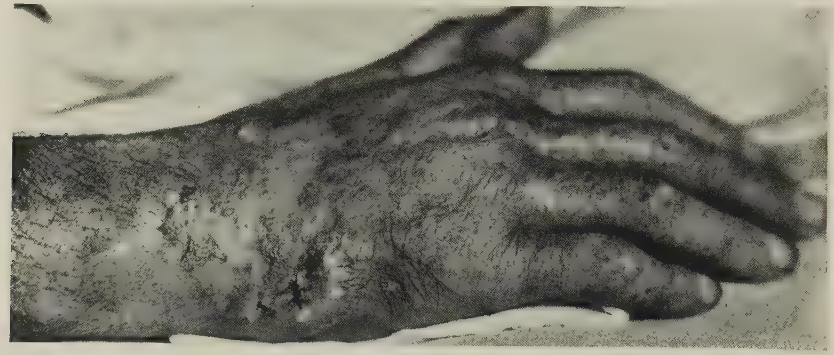

Fig. 979.—Ulcerating granuloma (granuloma inguinale) of hand. First recorded case in this location. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

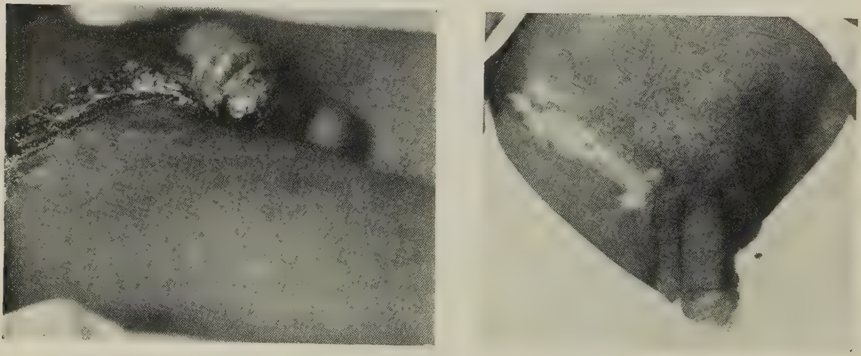

Fig. 980.

Fig. 981.

Figs. 980, 981.—Granuloma inguinale. Before and after treatment by injections of tartar emetic. (Courtesy of Dr. James G. Sargent.)

LYMPHOGRANULOMATOSIS INGUINALIS

Synonym.—Lymphogranuloma tropicum.

This disease is a form of inguinal adenitis and was first described in 1913 by Nicolas, Durant, and Favre, who considered it a specific disease which had previously been observed in the tropics under the term "climatic bubo" or "strumous buboes of the groin." In recent years careful studies made by numerous investigators have definitely established the disease as a clinical entity. It is a venereal disease transmitted by sexual intercourse, the cause being unknown.

Lymphogranulomatosis inguinalis usually begins as a pin-head sized, indurated, painless papule or herpetiform lesion or erosion on the glans penis or the prepuce in the male, or on the vulva in the female, following the incubation period of one to six weeks after coitus. This lesion is the only manifestation for several weeks and then the inguinal glands on one or both sides become swollen. Usually the condition is unilateral. In the beginning the glands are discrete, tender, and firm, but later become matted together and somewhat fluctuant; while the overlying skin assumes a purplish hardness, and ultimately breaks down, with simultaneous relief of pain. The area now is an indolent ulceration in which there are multiple sinuses extending to the deep, broken down glands. The iliac glands, as a rule, are also enlarged and tender, but do not suppurate. After several months the inguinal ulcerations heal, leaving puckered thick scars.

Prior to the establishment of drainage there may be general symptoms of intoxication, but otherwise the disease is of a local nature without characteristic changes in the blood count. Slight anemia is common.

The causative agent has not been determined. Among the organisms which have been recovered are diphtheroid bacilli, various amebae, streptothrix, and Micrococcus paramelitensis. Histologically, there is a diffuse granulomatous infiltration consisting of lymphocytes, plasma cells, endothelial cells, and miliary abscesses, with occasional giant cells. Small dark staining, round granules, so-called "gamma bodies," are found in the protoplasm of large mononuclear cells. Mast cells and polymorphonuclear leukocytes are present, and multinucleated giant cells and mitotic figures are rarely seen.

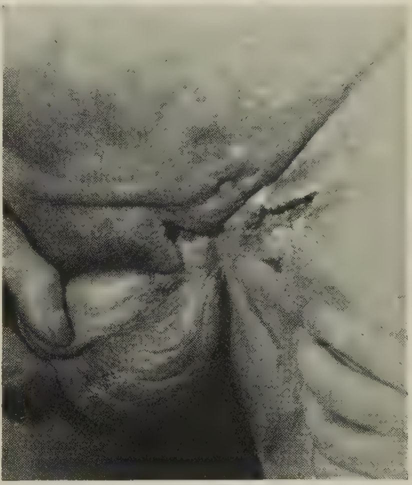

Fig. 982.—Lymphogranulomatosis inguinalis. Ulceration in left inguinal region of sixteen months' duration. (Courtesy of Dr. John A Hillsman.)

The disease is differentiated from granuloma inguinale by Hillsman, Wilhusen, and Zimmerman as follows:

"1. Granuloma inguinale is primarily a disease of the skin; lymphogranulomatosis inguinalis first involves the lymph nodes and only secondarily the skin.

"2. Donovan bodies can be demonstrated in the majority of cases of granuloma inguinale; these bodies are not found in lymphogranulomatosis inguinalis.

"3. Patients with granuloma inguinale usually respond quite favorably to treatment with tartar emetic; lymphogranulomatosis inguinalis is notoriously refractory to any therapy.

"4. The intradermal test of Frei and Hoffmann is presumably specific for lymphogranulomatosis inguinalis.

"5. The histologic picture of lymphogranulomatosis inguinalis is considered characteristic by most authors."

Frei and Hoffmann have reported that a typical skin reaction is produced in lymphogranulomatosis inguinalis by the intracutaneous injection of the sparse purulent material from the involved inguinal glands. This material is obtained by needle puncture and is diluted five to ten times by sodium chloride solution, is heated for two hours at 60 C. the first day and for one hour the second day; 0.1 cc. is injected intracutaneously. Strong positive reactions follow the injections in patients afflicted with lymphogranulomatosis inguinalis, but do not occur in controls. This test must be used for a longer period before its exact value is determined.

Treatment.—The treatment is largely surgical. In early cases roentgen rays are beneficial. According to Pardo-Castello, intravenous injections of Lugol's solution and injections of emetin are valuable.

MYCETOMA

Synonyms.—Madura foot, pseudo-actinomycosis, fungous foot of India, and several native terms.

Mycetoma is a parasitic disease, somewhat resembling actinomycosis, which produces a tumefaction, accompanied by the formation of nodules, tubercles and sinuses, usually of the foot. Although the disease occurs chiefly in India, cases have been recognized in various parts of the world, including the United States. The inoculation takes place principally on the soles due to going barefoot and causes a localized, painless infiltration, which eventually spreads and breaks down centrally, with the production of a viscid, oily exudate which contains variously colored granules. New nodules and new sinuses form and through fusion the involved area becomes larger until eventually there are an enormous swelling and hypertrophy with multiple sinuses, some of which extend deep to the bone. The progress is slow and as the foot enlarges the leg atrophies from disuse. The disease after decades terminates in death due to sepsis and exhaustion, unless the part is removed.

The granules in the discharge have been likened to fish roe. According to the variety of fungus they are yellow or ochroid, which is most common, or black or red, which is rare. Microscopically, the fungi are similar to the actinomyces, but there are several points which distinguish them morphologically and tinctorially.

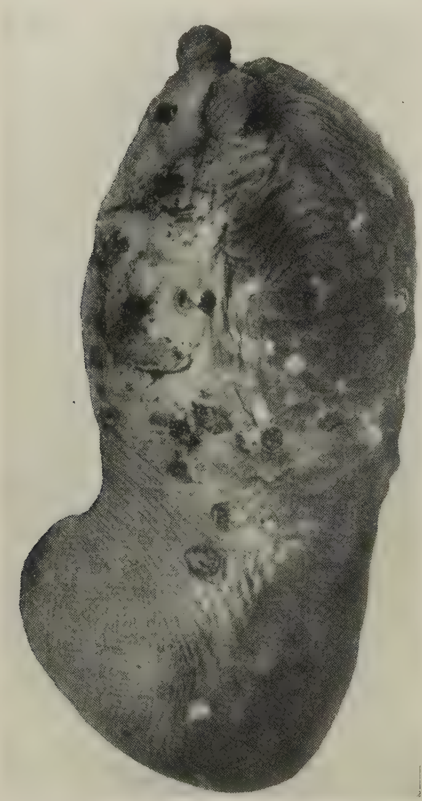

Fig. 983.—Mycetoma. Increased thickness of foot, forming an ovoid mass and obliterating the anatomical markings. Note discharging sinuses. (Courtesy of Army Medical Museum.)

Although the foot is the part chiefly affected, the hand and other parts have been attacked, never, however, combined with other areas.

Treatment.—Amputation is generally necessary. Patients in the early stage of the disease are successfully treated by thorough removal of the affected area by the actual cautery. Iodides are given, but their value is doubtful.

Accladiosis.—This is a tropical disease caused by a fungus, Accladium castellanii, which resembles sporotrichosis. Three types of lesions may be distinguished: (1) An epithelioid or tuberculoid type with the presence of giant cells; (2) a lympho-connective tissue type (syphiloid); (3) a polymorphonuclear type (ecthymatous). In well-marked cases ulcerative lesions occur all over the body though they are in smaller numbers or entirely absent from the face, scalp, palms, and soles. The characteristic ulcers are well defined and rounded, with red granulating bases, which may be covered with a purulent discharge or thick yellow crusts. The lesions may resemble gummas or furuncles and be associated with enlargement of the adjoining lymph glands. Usually the ulcers are but slightly painful and cause no itching. Moderate fever and some weakness may be present. The diagnosis is made by cultural methods, the hyphomycetic elements generally being absent microscopically in the scrapings from the lesions. The material is inoculated in dextrose agar tubes and the colonies appear four to eight days later as small yellowish amber-colored, rounded masses, which may or may not fuse. The disease is often mistaken for syphilis and yaws, being differentiated from these diseases by the negative serology and the lack of response to antiluetic treatment. The most effective remedy is potassium iodide in full doses, preferably given in conjunction with a salt-free diet. Local wet dressings of mercury bichloride, 1 : 2000, are advisable.

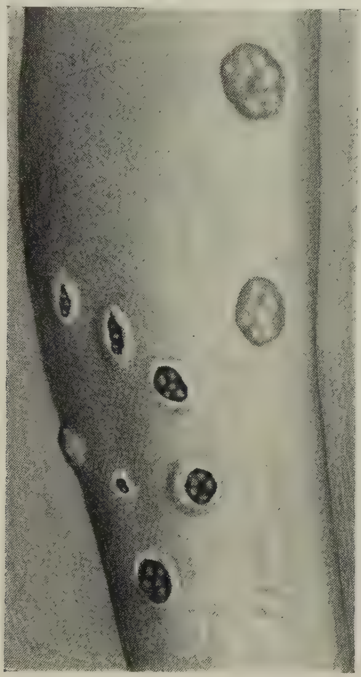

Fig. 984.—Accladiosis. (Courtesy of Sir Aldo Castellani, London, England.)

MOSSY FOOT

Mossy foot is a papillomatous disease of the feet and legs which occurs in the natives of the Amazon valley, and occasionally in other parts of Central and South America. The disease is apparently an infection by a yeast-like fungus, Phialophera verrucosa, and spreads by auto-inoculation. It has been transmitted to rabbits, producing similar warty lesions at the site of inoculation.

The early lesions are said to be vesicles, but the characteristic feature of the disease is dense, warty, painful papillomas which slowly develop and produce extensive verrucous masses. The dorsum of the foot is the most frequent part affected and from there the disease is likely to spread to the ankle, the sole usually escaping involvement. The actual cautery is recommended as the best form of treatment.

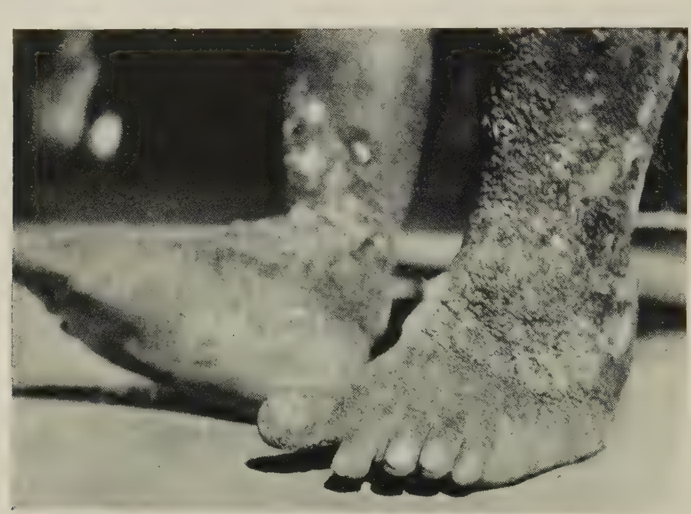

Fig. 985.—Mossy foot. Native of Panama. (Courtesy of Dr. Robert A. Lambert.)

PINTA

Synonyms.—Spotted sickness, caraate, and many native terms.

Pinta is a chronic skin disease endemic in tropical America, and occasionally elsewhere, which is characterized by variously colored spots on the skin and mucous membranes. The appearance of the disease varies somewhat even in the same locality, and the term "pinta" may apply to a group of related affections. There is a predilection for exposed parts, especially the face and neck. The lesions begin in one or two places and spread by extension and numerical increase. There is no tendency to spontaneous recovery, and unless eradicated the disease may persist indefinitely. The lesions are scaly, slightly pruritic patches of various shades of color, and at times they may be yellow, blue, violet, red, gray, bronzine, or jet black, or white, and intermediate tints. In the early phases the colors are brightest, but eventually the patches become atrophic and depigmented due to the effect of the disease on the melanin. The affection causes no marked symptoms. In cases observed by Fox in Santa Marta, patches of complete depigmentation suggesting vitiligo were the most striking feature. Closer study showed that, while individual patches were identical with vitiligo, their constant association with pigmented or partially depigmented areas did not leave any doubt that they were not of this disease. On the other hand, Sutton was impressed less by the resemblance to vitiligo and leukoderma in cases encountered in Columbia, and more by the bluish tints in the patches and the fine reticulated atrophy.

A mycotic origin is usually attributed to pinta, but this has not been substantiated except casually. Castellani found a fungus with all the characteristics of Malassezia tropica in some cases of yellow pinta, and in other cases no fungus of any kind. He states that the mycotic yellow patches are generally characteristic, being slightly raised and sharply limited, whereas the nonmycotic patches are not raised and the borders are not sharply defined. Possibly the latter variety represents a stage of partial depigmentation caused by a fungous infection or by syphilis. In black and blue pinta several conditions may be differentiated, some apparently being caused by fungi, whereas others are not mycotic.

Pinta fully developed is readily recognizable. Pale patches may be distinguished from leprosy by the absence of anesthesia and by their peculiar color, and from other fungous infections by the microscopical characteristics of the organisms.

Treatment is by the use of antiparasitic ointments containing sulphur, salicylic acid, and resorcin, or by painting the lesions with tincture of iodine, or a solution of chrysarobin in chloroform, and is often unsuccessful.

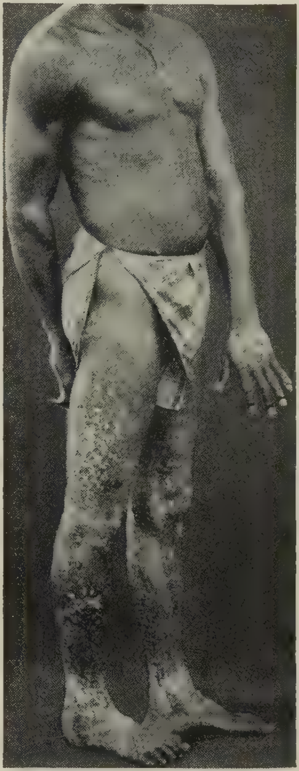

Fig. 986.—Pinta or caraate. (Courtesy of Sir P. H. Manson-Bahr, London, England.)

TINEA IMBRICATA

Synonyms.—Tokelau ringworm and various other native terms.

This is a fungous disease which is prevalent in some tropical countries. There are several clinical forms which may be caused by the same fungus, although two varieties have been distinguished—Endodermophyton indicum and E. tropicale.

The eruption begins with one or several small rounded brown spots on the arms, chest, or back. After a time each spot splits in the center and in this there is formed a ring of large flaky scales attached at the periphery. According to observers, this scaly ring extends peripherally, and while it does so another brownish spot appears in the center in the same site as the first spot, and undergoes the same process of splitting and peripheral extension. This formation is repeated over and over until complicated patterns are produced. When fully developed the eruption is characterized by concentrically arranged rings, or parallel undulating lines and scales which overlap one another like shingles on a roof. The scales are thin and grayish, sometimes several millimeters broad, and have curled-up edges, which in time become dark and dirty. All regions are attacked, and even the nails may become friable and stratified, although it is stated that the palms and soles, axillae and groins, and the scalp are usually exempt. There is as a rule more or less pruritus, but otherwise there are no symptoms. The course may be protracted, being worse during the wet season. When the spots disappear spontaneously, residual hyperpigmentation or depigmentation may occur, giving a piebald appearance.

The causative fungus is one of the hyphomycetes, being known as the Endodermophyton concentricum. According to Castellani, these fungi are characterized by their growth between the superficial and deep strata of the epidermis, forming an interlacing belt of mycelia, which detaches the horny and granular layers from the rete Malpighii. Microscopically, in scrapings there are interlacing septate mycelial filaments which branch dichotomously, and groups of polyhedral spores.

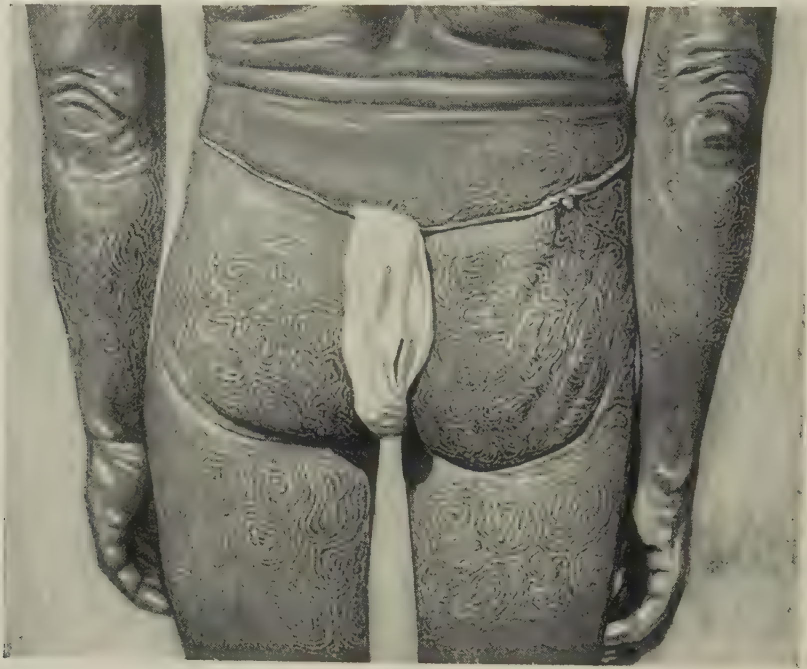

Fig. 987.—Tinea imbricata. (Courtesy of Sir Aldo Castellani, London, England.)

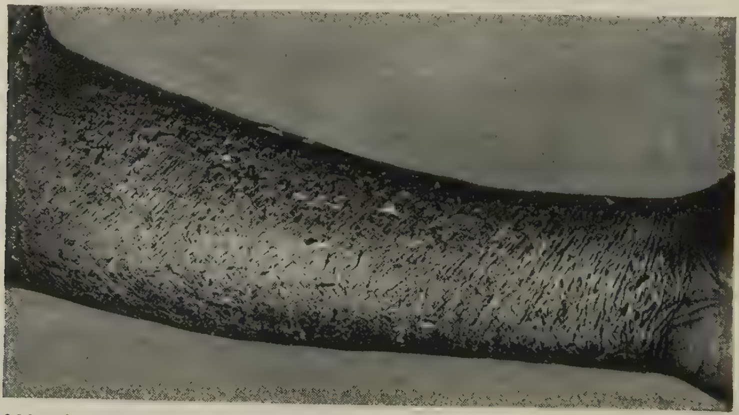

Fig. 988.—Tinea imbricata. (Courtesy of Sir Aldo Castellani, London, England.)

Tinea imbricata is distinguished from ordinary ringworm and from ichthyosis by the concentric arrangement of the scales, their peripheral attachment and by the abundance of the causative fungi.

Treatment is difficult due to the tendency to recurrence after apparently complete regression. It is said that the best results are obtained by the use of roentgen rays and a 20 per cent solution of resorcinol in compound tincture of benzoin. Tincture of iodine and salicylated alcohol are also recommended.

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